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The photograph reproduced below does not depict a model. It was taken by Mr. J. N. Maskelyne, and shows a G.W.R. stopping train from Reading to Marlborough passing over Aldermaston water-troughs. The engine is of some interest; she is No. 1335, one of three small 2-4-0 type tender engines taken over by the G.W.R. from the Midland and South Western Junction Railway, in 1922. All three are still at work, and are now the only examples of their type on the G.W.R.

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Vol. 82 No. 2017 January 4th, 1940

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Smoke Rings

One Hundred Years Ago

IF anybody told you that 100 years ago there was a MODEL ENGINEER in existence you would probably raise an eyebrow. Yet it is a fact that in 1837 a journal was published which, in its general conception and objects, was THE MODEL ENGINEER of those times. It was published in London, and its name was *The Penny Mechanic*. One of my readers has kindly lent me a copy of Vol. I, and I have found it of absorbing interest as a record of the state of engineering and applied mechanics a century ago. The Editor's preface to the volume so exactly outlines the purpose of THE MODEL ENGINEER that, with some slight modification of the rather pedantic language current in those days, it might well serve as a preface to a current volume of our own journal. Let me quote a few sentences:—" The Arts and Manufactures have not been neglected. Descriptions of many ingenious processes, which it required a work of this kind to make known, have been brought before the reader in a popular manner. The Student in the Sciences will find many papers in this Magazine worthy of his attention. Many ingenious pieces of apparatus have been noticed, and also the mode of constructing various kinds for illustrating facts in experimental philosophy in an economical manner." Very appropriately, the opening article in No. 1 is a description of a vertical steam engine and boiler, and in subsequent issues descriptions of various types of engines then in use are published. The writer of those articles must have had a shrewd anticipation of the enormous developments in the design and application of the steam engine which were destined to take place. He realised that steam power was, even in those days, becoming a most valuable aid to industry, for he says, " in the expansive force of steam we have a power which can engrave a seal, and crush a mass of obdurate metal like wax before it; draw out, without breaking, a thread as fine as gossamer, and lift a ship of war like a bubble in the air; or embroider muslin, forge anchors, cut steel into ribands, and impel itself against the opposition of the very tempest." In a later issue, there is an interesting paragraph on a proposed steam gun, from the barrel of which bullets are to be projected at the rate of several hundred a minute, by the action of steam at a pressure of 840 lb. to the square inch. The optimism of the inventor is expressed in the concluding words of the description, which run as follows:—" By many, the perfection of the invention is hailed as a benefaction which will put a stop to wars and to tyranny; for they say, as a few of these guns would sweep away whole armies from the face of the earth, where could the supplies of men be found, and what tyrant could oppress a people who were possessed of them?" There, at least, was the germ of the modern quick-firing gun, but what different ideas on warfare to end tyranny prevail in these days of modern science and invention, and of political greed and aggression. That remarkable little magazine, *The Penny Mechanic*, was full of bright ideas and miscellaneous scientific information. I do not know how long it survived, but it deserved well of a public thirsting for technical knowledge. Perpetual motion formed a subject of heated debate in its correspondence columns, the early days of railways and ship propulsion received constant editorial attention, and meetings of technical institutes and societies were reported, much as the meetings of model engineering societies are reported in our own columns to-day. The Society of Arts, as it then was, offered gold medals for " a method of generating steam in such a manner that its quantity or force shall be materially increased, without increase of danger or expense," and for " a method, superior to any in use, and verified by practice, of preventing the emission of dense smoke from the chimneys of furnaces and fireplaces." A hundred years have elapsed, and this smoke prevention problem is still with us! To crown all, I find in this entertaining volume an illustration and description of a gas mask. Designed to enable the wearer to penetrate the smoke-laden atmosphere of buildings on fire, it bears a close resemblance to the gas masks of to-day, produced for a very different purpose, in spite of the exuberant anticipations of the inventor of the steam gun.

The Late Capt. A. B. Lockhart

IT is with much regret that I have to record the death of Capt. A. B. Lockhart, D.S.C., R.N., who passed away at his home on December 14th. Capt. Lockhart was well known to many model engineers as a Director of Messrs. Bassett-Lowke, Ltd., having joined their Board in 1936. He was in the Naval Reserve, and re-joined the Navy on the outbreak of war, but failing health prevented him from taking up active service. Capt. Lockhart had a charming personality, and his loss will be mourned not only by his business colleagues but by many who had the pleasure of meeting him in connection with model engineering matters.

* * *

Negative Lead

SOME discussion seems to have arisen around the fact that Mr. A. J. Maxwell's G.W.R. 0-6-0 locomotive for 5" gauge is provided with negative lead. Quite frankly, this provision in such an engine was merely an experiment to determine: (a) the precise effect in so small a scale; and (b) whether any practical difficulties were likely to occur in the building of a valve-gear that embodied negative lead, when the gear is no bigger than one-twelfth full size. For a full-size locomotive, the effect of negative lead is well known, as demonstrated by the performance of the G.W.R. "Saint" Class 4-6-0 express engines, which have—or, at least, had—3/16" negative lead in full gear; in the model, therefore, a particular result was expected, and was duly obtained. It is that the engine may be somewhat slow in starting from rest, as compared with a similar engine with normal valve setting; but, when linked up, very high speed can be obtained without any serious drop in drawbar-pull. No practical difficulties were actually anticipated in constructing the tiny gear, and none occurred; but, in model work, unforeseen snags have a disconcerting habit of making themselves apparent. Some readers, however, seem to have taken the view that, if the provision of negative lead has shown itself to be of such benefit, then *all* locomotives should be provided with it. This idea is, of course, quite a fallacy, and shows that the fundamental considerations are not clearly understood. To begin with, the valve-gear itself has a considerable influence on the question as to whether the provision of negative lead is practicable; a Stephenson link-motion with open rods possesses the peculiarity that the lead increases as the gear is linked up, and, in certain cases, there is the possibility of this increase of lead becoming a decided disadvantage. In such a case, the provision of negative lead in full gear is desirable; and then only if the locomotive is intended for high-speed traffic. On the other hand, in a Stephenson gear with crossed rods, the lead decreases as the gear is linked up, and in this instance, provision of negative lead would be absurd; and so it would be in a constant-lead gear such as Walschaerts' or Joy's. There has probably never been a full-size goods locomotive that has had negative lead, and few express passenger engines, other than the G.W.R. "Saints" and, possibly, the "Halls." But the fact remains that, with due regard for the type of valve-gear, coupled with consideration for the work the locomotive is intended to do, negative lead can be, and undoubtedly is, advantageous. There is, however, a further very important consideration that strongly influences the question of whether negative lead can be adopted; it is that the valves must be arranged for long travel, so that their movements are as rapid as possible; and, to meet this condition, the ports must be suitably designed and as large as they can be. Unless the engine has large ports and long valve-travel, the provision of negative lead would probably result in complete failure, not only from trouble in starting, but, also, in serious loss of drawbar pull when running at speed. Further, the valves should have a lap equal, at least, to the width of the steam admission ports, if the best results are to be obtained. In Mr. Maxwell's engine, the valve-gear was designed for a full-gear cut-off of 85 per cent., by making the lap of the valve equal to the width of the steam port. The negative lead was then obtained by adding a further 1/64" to the lap, which has the effect of bringing the full-gear cut-off back to about 80 per cent. Had this arrangement not proved successful, the remedy could have been very easily applied; all that would have been required is that the 1/64" extra lap could be filed off the valves. So, if any reader is thinking of providing negative lead to any model locomotive, he should be careful to make sure that all the conditions are suitable for it; otherwise, the effect may be disastrous.

* * *

Manning the Machine Tools

THE importance of the machine tool operator in the national armaments production scheme is emphasised in a letter to the *Times* by Sir Alfred Herbert, who is a leading figure in the machine tool industry, and was Controller of Machine Tools in the last war. He states that less than half the machine tools at present installed in factories are working at their full capacity, because, under present conditions, labour is not available to run night shifts; and that if the machines were adequately manned and run at their full capacity, it would be possible to increase production by one-third without any additional capital expenditure. The unemployment problem, he suggests, might be completely solved if surplus workers were trained and organised to fill this deficiency. This pronouncement entirely supports our frequently-expressed views regarding the value of skilled craftsmen in times of national emergency, and we have little doubt that model engineers and amateur mechanics, whatever may be their vocation in normal times, will play a great part in keeping the wheels of industry turning in this war, as they did in the last.

Percival Marshall

ENGINES

Some early memories

By B.C.J.

IN considering the whole question of model making, and particularly that part of it which deals with the important matter of "what to make," one cannot resist the conclusion that the declining years of last century were more prolific than any in regard to the variety of engine types that were available for treatment in the model workshop. (This statement does not, of course, refer to the locomotive—which will not again receive mention in these notes—but to the not at all less interesting *stationary* engine, whether it be steam, gas or hydraulic.)

The writer must insist at the outset that the stationary engine, in its model form, has really most important advantages over the still popular locomotive. The former, the stationary engine, does not require a quite considerable space for its track; it can be placed on a table or bench, where the owner may be seated in comfort near to it. All the "controls" can be handled *while the model is under steam,* and the owner can get a "close-up" view all the time; and if variety is needed, then the appliance selected to absorb the power of the model can be changed—dynamo, compressor, fan and so on.

Referring again to the question of variety of type, one feels that those mechanically-minded persons whose 'teens happened to coincide with late Victorian times should consider themselves fortunate, for electricity had not then rendered superfluous the small steam engine and gas engine—and low speed of revolution, surely an asset to the model engine, had not given way to speeds at which moving parts, if indeed they are not enclosed, become practically invisible to the eye.

Now, the purpose of this article is to describe briefly a few of the really most interesting engines that came under the writer's notice prior to the year 1900, and to discuss—also briefly—their model-making possibilities.

A short distance from the scholastic academy where certain gowned gentlemen attempted to cram the writer's head with knowledge—and failed—was a carpenter's shop where was installed a lathe, a circular saw and, perhaps, a few other wood-working tools. To provide driving force for these appliances there was a small hydraulic engine of unknown horse-power. This engine had three cylinders fitted with rams and a three-throw overhead crankshaft. The cylinders oscillated on a hollow ported trunnion with, presumably, a diametrical partition to divide the high-pressure water supply from the discharge. There was, I think, no flywheel, but merely a fairly large belt pulley for, of course, the speed of the engine was slow. As can be imagined, there was a good deal of leakage, and on opening the starting-valve—by means of a large wooden T-handle—there was much "swishing" of water while the engine laboriously got itself into a state of motion.

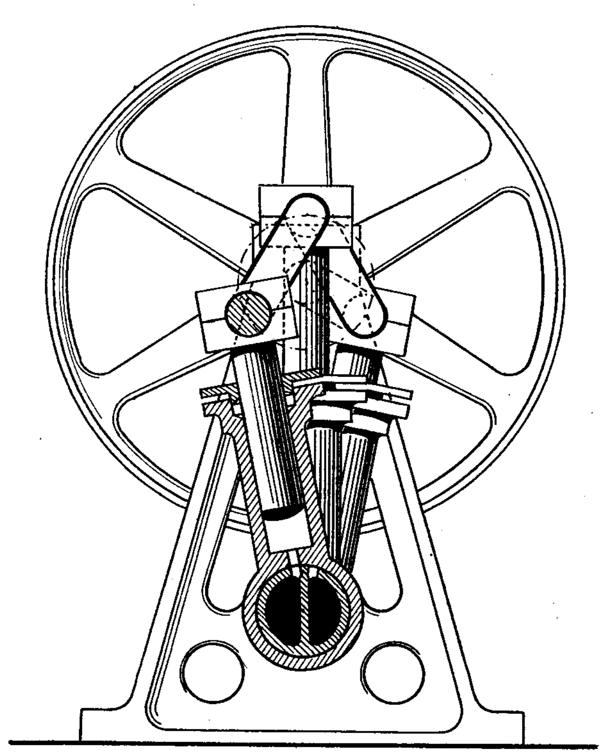


Fig. 1. Small three-ram hydraulic engine at work in a carpenter's shop.

Fig. 1 is a sketch of the engine so far as I am able to reproduce it from memory. The internal anatomy of the hollow trunnion—shown in section in the sketch—was, of course, never actually open to inspection; it must, however, have been of some such form as that indicated in the sketch. The crank-pins would be placed at 120° to one another, so that there would be no "dead point." With the exception of the three-throw crankshaft (a rather awkward object to bend) and possibly the hollow trunnion, the engine should come down rather well in scale, and could, indeed, be made to almost any dimensions. Probably the D-shaped ports in the trunnion could, in the model, be of *circular* shape, so that drilling could be resorted to, and this would apply also to the radial ports leading to the respective cylinders and rams—though these latter could without difficulty be filed to rectangular shape similar to that of a steam-cylinder port.

The crankshaft, if the bent shaft is objected to, could, with a little ingenuity, be a built-up one—four discs for the webs being turned in the lathe and drilled to take the pins and shafts. As for the side-frames, these should take the form of the letter "A," the bearings being situated at the apex and provision being made for the support

and secure fixing of the hollow trunnion near the base of the A-frames.

This little engine—I have never seen another like it—is, of course, only one form of hydraulic engine, there are a number of others, and, indeed, several have been described previously in these columns.*

Some considerable number of years before a disastrous fire brought the major portion of the Crystal Palace at Sydenham to a state of almost complete ruin, there used to be, not far removed from the "central transept," a really beautiful piece of steam engine construction—in the form of a large horizontal compound condensing engine. The engine drove a dynamo by means of a belt, and was a source of very considerable interest to visitors to the "Palace"—and to the writer it provided the most intense pleasure. Being of horizontal construction, all the moving parts could be viewed with ease, assisted by the fact that its speed was slow and did not much exceed 120 r.p.m. Then again, although a polished hand-rail surrounded the engine to prevent the public approaching dangerously close thereto, this rail served to provide the writer with a convenient resting-place for his elbows while he indulged in the four-fold delights provided by the sight of the many polished moving parts, the regular mechanical sound of rods and pins, the hiss of escaping steam, and, finally, the very attractive odour of hot oil. Much time must have been spent—by the writer—in devouring this beautifully kept and attractive piece of machinery.

In Fig. 2, an attempt has been made to depict the engine—in plan—and let it be said that the drawing is entirely from memory. Now let me describe this treasure. As a compound, the engine had two cylinders, high and low pressure; the H.P. cylinder would be, perhaps, 18" diameter and the L.P. in proportion. The cylinders were "lagged," according to the pleasing custom of the time, with polished mahogany held in position by brass bands. The drawing shows the crosshead guides as being of the "bored" type—they may have been otherwise, but the connecting-rods were decidedly of marine pattern, i.e., they were of circular cross-section with bolted big-ends. The two-throw crankshaft was truly a nice piece of design, the webs shaped in the manner shown in sketch *A*, Fig. 2, but there was hereabouts a peculiar feature. The cranks were not set at right-angles to one another as one might expect, nor were they opposed, but the interval between them was about 165°. The purpose of this feature, one imagines, was to provide approximate balance and at the same time to allow no "dead-point"—so that the engine could be started from any position at which it may have stopped. Pits were provided in the bed-casting for the cranks. The high-pressure cylinder had a valve-chest in which was contained an expansion-valve working in combination with the normal valve; the expansion-valve being controlled as to its cut-off by a link mechanism and "Porter" governor. All the parts in this vicinity were particularly pleasing in design and their relative movements were interesting to observe when the engine was working close to its maximum load.

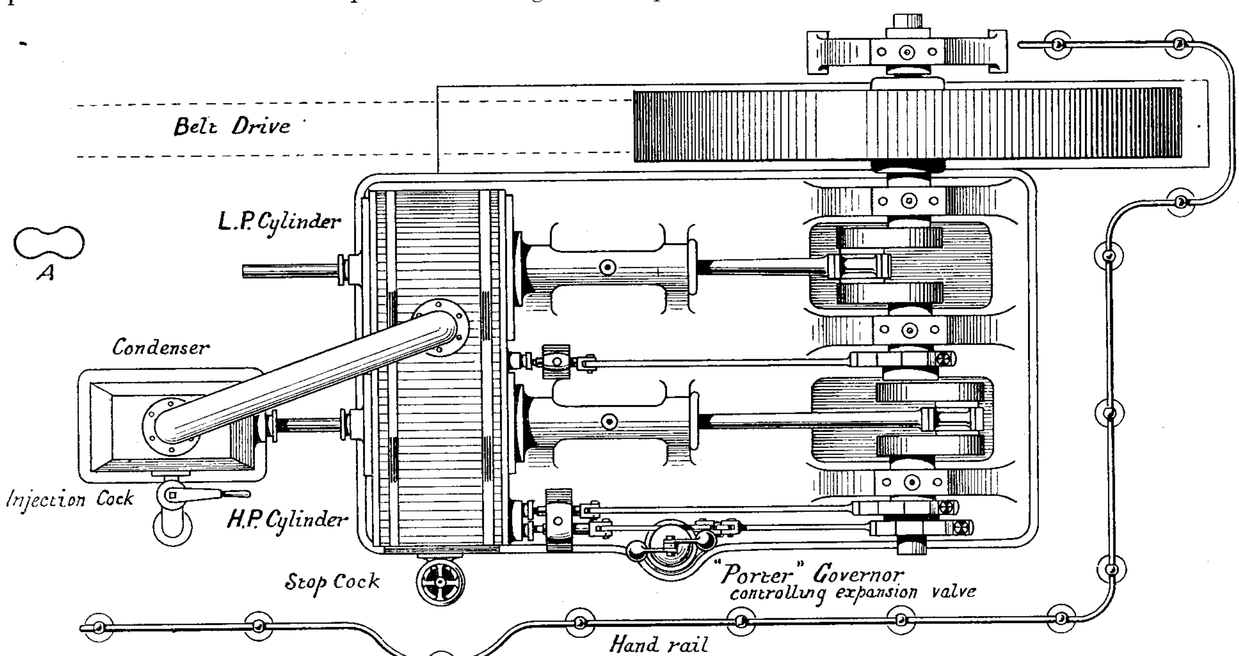


Fig. 2. Sketch plan of a horizontal compound condensing engine in operation for many years at the Crystal Palace.

* See THE MODEL ENGINEER, January 15th, 1925, "Model Reciprocating Hydraulic Engines."

Immediately behind the H.P. cylinder—in tandem—was a jet-condenser; the air pump being driven from the H.P. tail-rod. A handle and cock at one side of the condenser controlled the amount of injection water. The flywheel was of unusual width—for belt-drive—and its diameter—one does not care to guess at it—was certainly large for a steam engine. Indeed, as before inferred, the whole engine, with its great flywheel revolving, its crankshaft and connecting-rods flashing reflections from the bright arc-lamp overhead, its eccentrics in motion, its governor weights rotating and sundry links and spindles all performing their several functions, really provided a most pleasing aspect.

Now as to the model-making possibilities. Once provided with a good set of working drawings, time and skill should render it possible to produce a small scale model of an engine such as described and illustrated. As a starting point, the H.P. cylinder should not be less, perhaps, than $1\frac{1}{2}''$ in diameter, with a stroke of say $2''$. Many important dimensions would follow from these assumptions—length of connecting-rods, crankshaft proportions, bearings and so on. It should not be, if desirable, at all impossible to introduce certain *standard* parts, as supplied by the well-known model-makers—connecting-rods, flywheel, bearings, and perhaps cylinder castings and others.

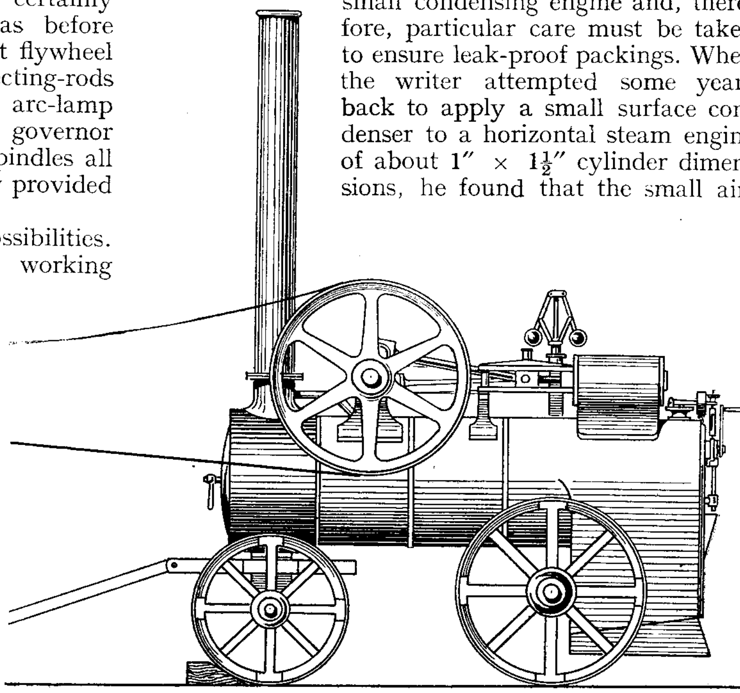


Fig. 3. A portable or "Agricultural" engine.

In respect to the condenser, the body of this could quite well be made from sheet metal (brass) and heavy gauge brass tube would, when bored out, make a perfectly satisfactory air-pump barrel. For the valves, phosphor-bronze balls would serve, and these could be housed in suitably drilled rectangular valve-boxes. Although in the actual engine the air-pump would probably be *double-acting,* for simplicity's sake the pump had better be *single-acting*. Besides simplicity, this feature would give the advantage that there need be no stuffing-box (save a dummy one) for the pump-rod. By the way, air-leakage through the engine stuffing-boxes is likely to be troublesome in any small condensing engine and, therefore, particular care must be taken to ensure leak-proof packings. When the writer attempted some years back to apply a small surface condenser to a horizontal steam engine of about $1'' \times 1\frac{1}{2}''$ cylinder dimensions, he found that the small air-pump fitted was quite incapable of dealing with air leakage. Thus when the vacuum first became effective the engine "raced," but very quickly slowed down owing to the above cause.

Now to turn to a very different class of steam engine. Before the advent of the oil engine, there were a great number of "agricultural" steam engines at work in country districts. Fig. 3—sketched from memory—gives a fair idea of one of these rather picturesque little engines. Probably few of them developed more than three or four horse-power and they were used for all kinds of farm work, but notably for threshing. At the proper season of the year, when enjoying a country walk, one quite frequently, directed by certain puffing noises and clouds of steam, came upon one of these engines at work, half a ton of coal lying on the ground near to the firedoor and a supply of water in a galvanised tank, waiting to be forced into the boiler by an eccentric-driven pump. There was quite considerable noise too, derived from exhaust steam discharged into a tall chimney, the flapping of the driving-belt against

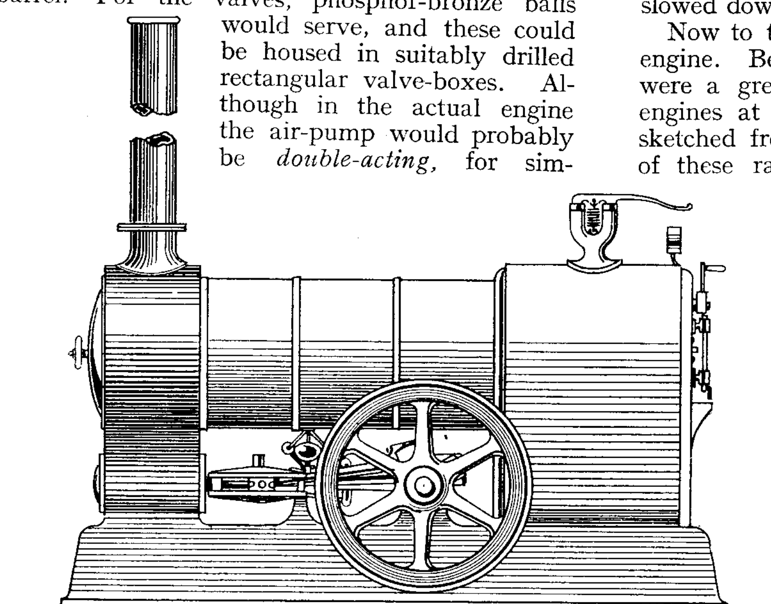


Fig. 4. An undertype engine—usually compound.

the face of the flywheel, steam hissing from the safety-valve—and from other places—and sundry knocks of a mechanical nature from the big-end, the small-end and the knuckle-joint pins, and other squeaks and rattles due to the two-fold fact that the engine was mounted on wheels and that it was looked after by no one more skilled than a farm labourer.

With the exception of the slight difficulty of building up the flat-spoked wheels on which the whole engine and boiler are mounted, there does not seem to be any detail beyond the skill of the average model-maker, if he were to decide to build a scale model of one of these engines. One detail would certainly need a little skilful pattern-making, viz., the saddle-shaped bracket supporting the crankshaft bearings. The cylinder, too, really calls for a special pattern, having a saddle-shaped base for suitably mounting on the firebox.

The boiler being of locomotive type, can follow, in its interior design, any loco. boiler of similar scale, i.e., it can have fire tubes, three or four in number, or it can be of the well-known water tube type. The boiler fittings are all quite normal, of course, and the flywheel. As for the chimney, brass tube, not forgetting the stiffening-ring at the top, will serve admirably.

Flat slide-bars are correct (or possibly a bored guide) for the crosshead. Avoid, at all costs, a *forked* connecting-rod, a most unsightly piece of mechanism. A crankshaft of the " bent " type should certainly be brought into use if it can be made successfully without the necessity for dies, or if it can be purchased ready-made.

Would not an " agricultural " or " portable " engine, such as has been described, made to a fairly large scale, with coal-fired boiler, make a rather satisfactory engine for use in the garden on a fine summer afternoon or in the workshop on a wet one

A very similar type of engine, the undertype, is illustrated in Fig. 4. This type of engine was quite a popular form of prime mover at one time, partly, perhaps, because it combined the economy of the locomotive type of boiler with a conveniently placed horizontal engine directly beneath the barrel of the boiler—where it occupied space that could not be more conveniently made use of. Most of such engines were " compound " and few, if any, had a single cylinder only. The remarks made in connection with the " agricultural " engine apply equally to the " undertype," and those who are accustomed to the making of locomotives will find no difficulty whatever in making the various parts of this model.

One of the features of the type is the base, which forms a support for the firebox and the cylinders, and should include the crankshaft bearings and, perhaps, a support for the ends of the slide-bars as well. The design and shape of this casting will have much effect upon the appearance of the finished engine. The usual form of forged or stamped double-throw crankshaft is applicable to the engine and a fairly heavy flywheel is an advantage to this—and, indeed, to any small steam engine. Well finished and well kept fittings are much to be desired, and the final painting is worth any amount of time which may be spent upon it.

During the period which is defined at the commencement of these notes, the small gas engine was a very commonly used machine for supplying power for all sorts of appliances, dynamos, fans, pumps, soda-water machinery, small workshops—they were, indeed, employed in every kind and sort of trade—butchers, bakers, and perhaps even candlestick makers.

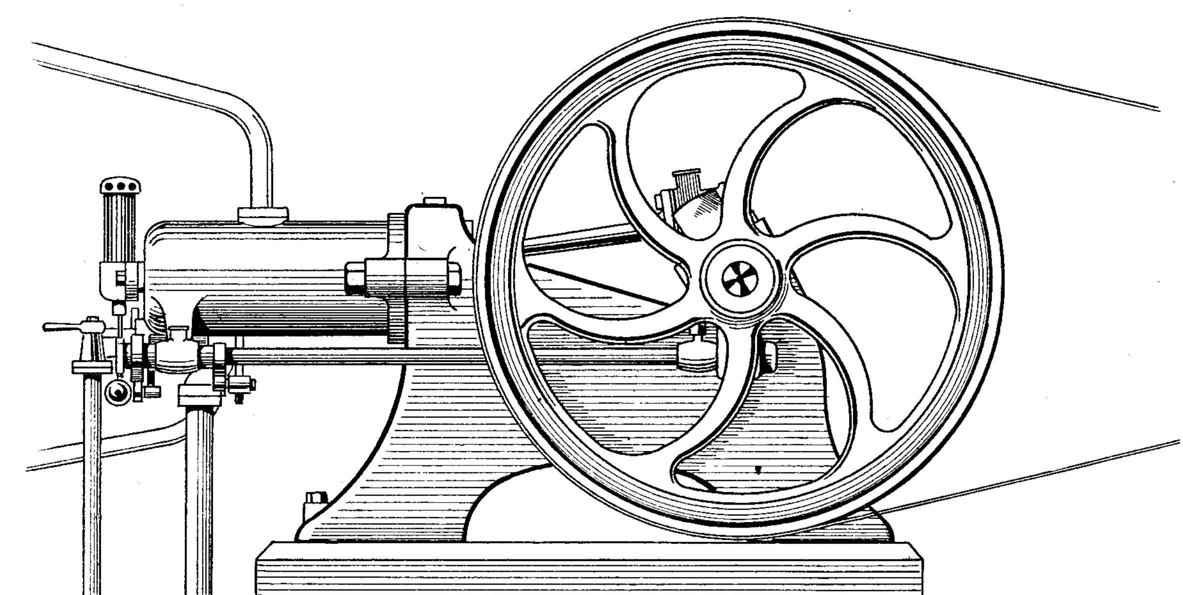


Fig. 5. The ubiquitous gas engine with its two-curved spoked flywheels.

Some of the early engines, of not more than two or three horse-power, were indeed very pretty little machines. The writer has attempted a sketch (in Fig. 5) to indicate the main features. An overhung water-jacketed cylinder bolted to a main box-bed casting which held the crankshaft bearings at the forward end, and was elsewhere curved and shaped and bossed and bracketed to give support and to accommodate surrounding details, a very substantial crankshaft, nicely proportioned, two large heavy flywheels with polished faces and well curved spokes, the latter most convenient for pulling round the flywheel to set the engine in motion, a marine pattern connecting-rod, a side-shaft in substantial bearings driven by skew-gearing, a centrifugal or a "pendulum" governor working, like the average boxer, on the "hit and miss" system, sundry cams, rollers, springs, rocking levers, and, finally, an ignition system consisting of a small tube at red-heat, tucked away in a chamber with perforated top, from which a bunsen flame of bluish hue could be seen issuing.* This was the gas engine of about the year 1900, forty years since.

Now in discussing the model possibilities of these engines, all the parts described can be made without much difficulty, and quite accurately to scale, all the parts except the rather important ignition device, that is to say. This was always the stumbling block. The ignition gear had to be proportioned so much out of scale that it became an absurdity. Even an engine owned by the writer, with a cylinder diameter of 2″, had a chimney for the ignition tube of about the same dimension—2″. (Another little engine constructed had quite a compact and sightly device to fire the cylinder charge, but this was not a "compression" engine.†)

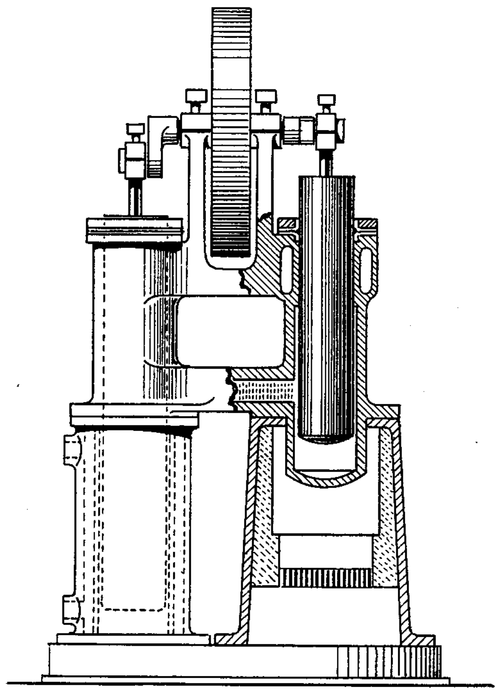


Fig. 7. A typical hot air engine.

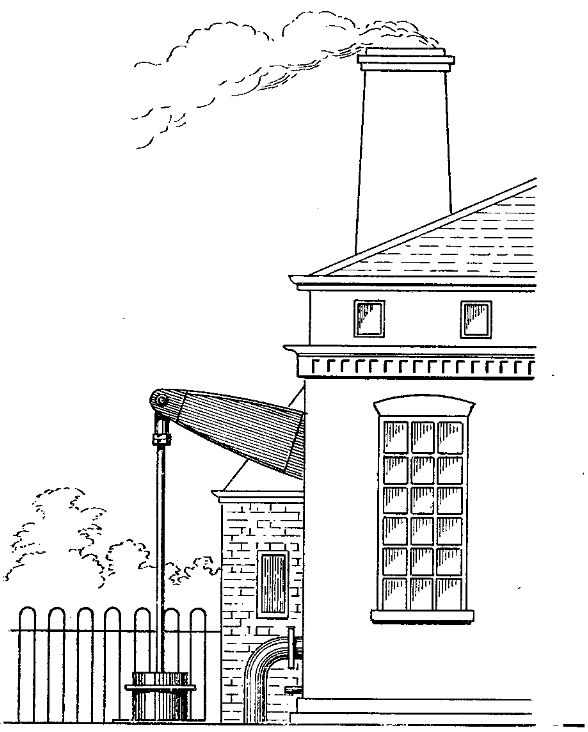


Fig. 6. Pumping engines, of which little more than the beam was visible.

The ignition difficulty could be met fairly well now by H.T. electrical ignition, certainly not by a magneto.

For the quite small scale model, it really seems best to be content with small power output and strict adherence to scale by the simple process of cutting out compression altogether. This process was, in fact, carried out by a continental maker who produced some very nice little models which worked extremely well and were of excellent workmanship. (This was, however, prior to the war which was prior to the present one.)

The small gas engine of the 'nineties was really a fascinating machine, and, indeed, so enthralled did the writer become in this source of power that for some years the steam engine fell into disfavour as a source of interest.

But to return once more to the steam engine; there was yet another type of engine, of very slow speed but of very great interest none the less; the pumping engine. Unfortunately, one could not frequently get a view of much more than a large rocking beam protruding through an opening in one wall of an engine house, presenting an

(*Continued on page* 10)

* Some of the smaller engines were fitted with "flame" ignition, of course, the flame being carried in a slide. One objection to this system was that a puff of air sufficient to blow out a match would stop the engine.

† For a description of this engine see THE MODEL ENGINEER of June 5th, 1924.

Model Engineers and National Service

*Capstan and turret lathes

By Edgar T. Westbury

In order to ensure that the tool head always stops in exactly the right position, and is locked against any disturbing forces while the tools are at work, a spring index bolt or catch is fitted to the capstan or turret slide, engaging in equidistant holes drilled in the head. The bolt must, of course, be withdrawn during the period that the head is being rotated; this is effected by means of a ramp or cam on the stationary part of the slide, which comes into engagement with a lever which operates the index bolt, and so draws it out of engagement with the turret head, just before the ratchet wheel engages with the pawl lever. The withdrawing lever runs completely over the ramp and re-locks the turret head at the end of the stroke; on the return stroke it runs over the ramp without operating the bolt.

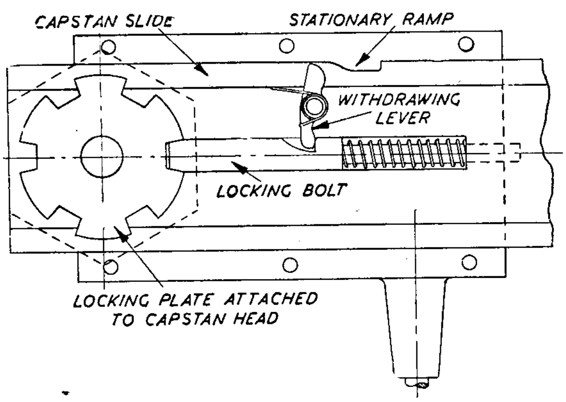


Fig. 2. Capstan head locking gear.

The mechanical details of the indexing and locking gear vary considerably on different types of machines, but in nearly all cases they operate on substantially the principles outlined above. A nut or hand lever for clamping the tool head is provided on nearly all machines, so that the locking bolt or pawl is relieved of any side strain which may be caused in the action of the tools.

Sliding Saddle and Cross Slide

In the simpler types of capstan lathes having no provision for sliding movement of the tools, the baseplate of the cross-slide is simply clamped to the bed, but in most popular modern lathes, a sliding saddle is found highly desirable. As already stated, the cross slide usually carries both front and rear tool posts, and it must be of extremely robust design, with sliding ways extending the full width of the lathe bed, as it is required to withstand heavy cutting thrusts, both upwards and downwards.

Provision for locking the saddle securely to the bed is most essential, as its definite location is highly important when forming and parting-off operations are carried out. The use of the sliding saddle should, in a general way, only be indulged in when dealing with work having tool operations too numerous, or of such a nature as to be unsuitable, for handling with capstan head tools. Any complication of the slide movements, beyond that necessary to deal with the class of work comprehended in the production scheme, is thus actually a disadvantage, as there are more things which can go wrong, or become deranged in the hands of careless operators; which explains why, in some production factories, the best results are obtained with machines in which the motions are resolved to their simplest essentials. Nevertheless, the increasing complexity of components employed in modern engineering renders the fully-equipped lathes absolutely necessary in many cases.

Limit stops must be provided to cover all motions of slides; these will be dealt with collectively under a separate heading. The photo of the sliding saddle and cross-slide of a Ward 3A capstan lathe shows the stop bar for the longitudinal travel of the saddle; it will be seen that this has four pairs of stops, which can be indexed into position to correspond with the tool positions when using the four-way tool-post.

It will also be noted, by examining the same photograph, that the two tool-posts mounted on the cross slide are of a simple but massive type, and are secured by long bolts, the heads of which are anchored in Tee-slots cut in the slide. The front tool is fitted to a slot running lengthways of the slide (i.e., across the lathe bed) while the other runs across it. (See also Fig. 4.) This ensures that the tool post is positively prevented from slipping in the direction of the main thrust likely to be encountered by its cutting tool, and the relative positions of the tools to each other can be pre-adjusted, so that they can both be used at the same setting of the saddle.

It is not usual to provide any form of swivelling slide on a capstan lathe, though the tool-posts themselves may in some cases be capable of swivelling. Sliding motion at an angle to the main slide, when it is required, is generally provided for by a special slide attachment or tool fixture, details of which will be given later.

* *Continued from page* 710, *Vol.* 81, "*M.E.*," *December* 28, 1939.

Limit Stops

The repetition of exact dimensions in capstan and turret lathes depends very largely on the provision of limit stops, which are set to correspond with every tool operation, and are brought into action either manually or automatically as required. On the capstan slide, the stops consist usually of long set screws with lock nuts, which are fitted longitudinally into a rotatable holder or " barrel, at the rear end of the slide, in such a way that only one of the screws at a time will abut against a fixed stop, attached to the stationary part of the slide, at the forward extremity of the stroke. (Fig. 3.) By rotating the barrel, each set screw in turn is brought into position to engage the stop, and by screwing it in or out, the extent to which the slide can be brought forward can be varied.

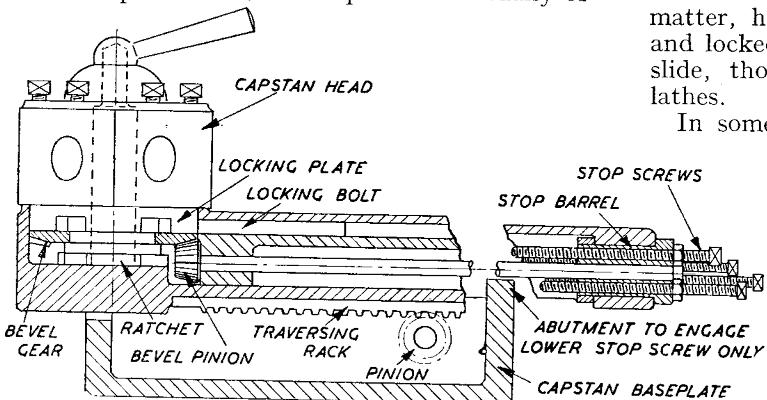


Fig. 3. Section of capstan slide, showing geared stops, also indicating relative positions of locking and indexing gear.

The number of stops fitted to the slide must of course correspond to the number of stations on the capstan, and if both are numbered, or otherwise marked, the appropriate stop for each tool operation may be selected by hand. Automatic operation is, however, more convenient, or (if the term may be permitted) " fool-proof," and may be simply carried out in this particular instance. One method which has often been employed in the past is to make use of the swinging motion of the pawl, which engages the ratchet of the tool head for self-indexing, to operate another ratchet on the stop barrel. A disadvantage of this motion, however, is that the barrel is left free between strokes, and may possibly be inadvertently turned by hand, thus destroying the synchronisation between the tool head and the stops, or in other words, putting them " out of step." Cases have been known where careless operators have carried on for some time with the stops out of step and have produced a beautiful heap of scrap before the error was checked. Trouble is also possible through sticking or deranging of pawl springs.

Most modern capstan and turret lathes have the tool head and stop barrel positively geared together by means of bevel gears, thus making it impossible for them to get out of step under any circumstances. It is by no means so simple a matter, however, to arrange positively indexed and locked stops on the sliding saddle and cross slide, though it is successfully done in some lathes.

In some of the smaller lathes, the cross-slide stops consist of small tongued blocks bolted into tee-slots or dovetailed grooves in the side of the slide and arranged to butt against a projection, sometimes made so that it can be swung into or out of action, on the saddle. Fine adjustment of the stops on this slide is not usually so essential as in the case of the capstan slide. (Fig. 4.)

The sliding saddle must also be fitted with stops; those of the Ward lathe have already been mentioned, but by way of further explanation, it may be noted that the bar to which they are attached is mounted in bearings fixed to the lathe bed, and can be rotated into four positions, where it is spring-locked to prevent accidental movement. The stops themselves consist of small angle brackets clamped into dovetails running the full length of the bar, and are fitted with fine adjustment set screws and lock nuts. They provide for limiting the motion in both directions, the apron of the saddle being equipped with a lug which carries set screws on either side, so located as to abut against the stops which are in the uppermost position on the bar.

In addition to positive stops, most modern

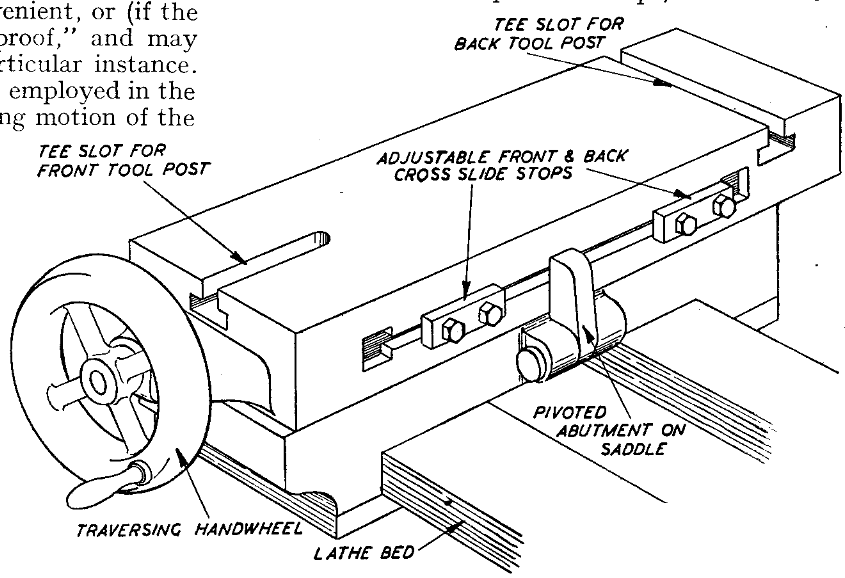


Fig. 4. Cross slide of capstan lathe, showing front and back stops and tee-slots for securing tool-posts.

lathes have indexed slide screws which can be used in lieu of, or supplementary to, the stops. Some of the Herbert lathes may be equipped with a simple form of index on the capstan windlass, which enables the operator to avoid errors which might be caused by variation of force in bringing the slide up to the stop.

It is, of course, most important that all the stop fittings should be of robust proportions, and so mounted and located that they cannot be "sprung beyond their proper limits by any force that the operator can normally exert. The rigidity of the stops is the limiting factor in the accuracy of the work which can be turned out.

The position of the work in bar-feed lathes must be set by means of a stop, which in most cases is carried in a capstan tool holder, which is brought up to the limit of its travel as soon as a piece has been parted off. The collet chuck is then released, and the bar allowed to feed forward by the gravity or other feed gear until it abuts against the work stop, when the chuck is closed, and in this way the correct amount of material is left projecting from the chuck to form the length of work required. A plain piece of steel bar, faced off truly on the end, is often used as a work stop, but in large quantity repetition work, it is safer to use a hardened stop, to avoid errors which might be caused by wear of the face.

(*To be continued*)

Engines—Some Early Memories

(*Continued from page* 7)

appearance somewhat as suggested in the sketch (Fig. 6). This beam rose in a stately manner to its highest position, paused, apparently to consider its next move, and then descended with a rush. Through the window of the engine house could be seen certain "plug" rods and catch levers, but little more. However, these great beam pumping engines were so alluring, situated as they sometimes were in quiet country districts, that the writer was once led to attempt a small working model. The beam was copied rather closely from a sample engine at work within a mile of the home "workshop," but as for all the interesting parts attached to the "steam end" of the beam, these would, of necessity, have been products of the imagination if it had not been for the fact that the Science Museum at South Kensington provided a wealth of detail of all sorts and kinds of beam and other pumping engines.

If, therefore, any reader thinks of setting to work on a pumping engine somewhat of the kind that has been very slightly outlined, one can only suggest that he should follow the writer's example and pay one or more visits to the South Kensington Museum, take pencil and paper, make a lot of notes and sketches, which is quite permissible, and perhaps purchase a photograph or two. The building of a really large-scale model beam pumping engine, the beam being, perhaps, as much as four feet in length, has always been a dream of the writer. But it seems that while the *dream* may remain, the *beam* will not now materialise.

Mention of still another kind of prime mover seems to be called for before concluding, and though many engines of this category, the hot-air engine, were at one time built, one doubts whether any factory in the country is at present or has for some time been engaged in their manufacture. The characteristics of the engines were peculiar; the bulk was enormous in proportion to the power given out and the cost of manufacture must have been high; and the weight, too, excessive, thus anything beyond two, or perhaps three, horsepower was quite out of the question. Disadvantages all these undoubtedly were, but on the other hand the engines were not uneconomical, and they were simple, silent and safe; one never indeed heard of a hot-air engine *blowing up*.

The main features of engines of different makes were rather similar. A trunk piston to transmit the rise and fall of pressure to the crankshaft and flywheel, and a "displacer" to transfer air from one side of a chamber, which was *hot*, to the other side which was *cold*. Fig. 7 represents a, perhaps, typical engine, which displays, indeed, all the usual working parts—piston, displacer, crankshaft, connecting-rods and flywheel. There is nothing here difficult to make if any be tempted, but some of the parts must be capable of withstanding considerable heat, *that* is of importance.

It should, perhaps, be remarked before bringing these notes to a close, that none of the illustrations included have been taken from examples or from actual drawings of the several engine types described; they have been evolved from the memory alone and are intended merely to suggest characteristic features, and as such they may, perhaps, serve their purpose well enough.

The writer expresses a hope that the somewhat sketchy descriptive matter given in the preceding pages will, in the case of the man of a little more, perhaps, than middle age, awaken pleasant memories of early model engineering experiences, and, perhaps, serve as an urge to further model making. It is to be hoped, too, that men of a later generation will also derive a little pleasure from what, to them, may seem to be in the nature of a mere historic survey, and little else.

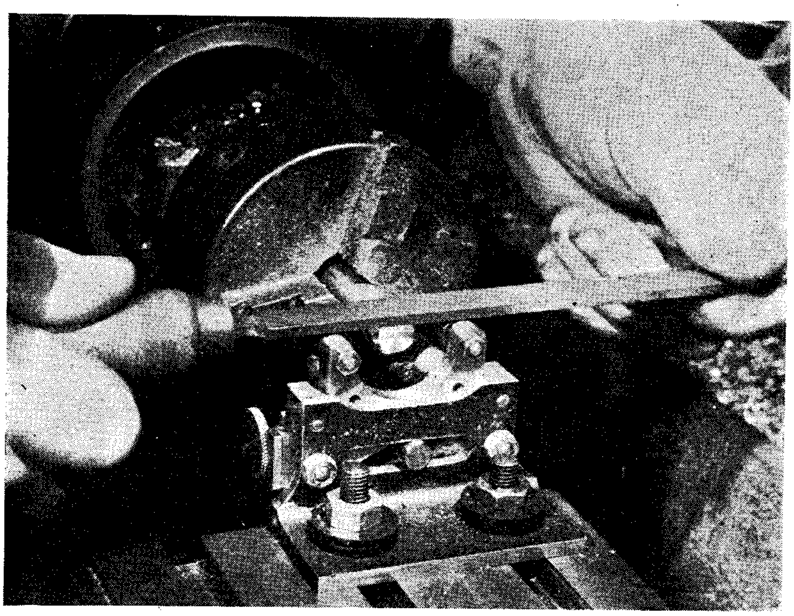
*A Roller Filing Rest for a 3-in. Lathe

By " Ned "

Vertical Slide and Supporting Plate

The slide is made from a piece of $1\frac{3}{4}''$ by $\frac{1}{4}''$ flat bar, and in this case also, care must be taken to select a piece which is straight and true, and in particular, free from twist. There is only one really important machining operation on this item, namely the cutting of the inclined slot, which may be milled in the same way as that in the angle bracket, but a different method of setting up is, of course, necessary. In this case, after marking out the centre line by measuring the exact distances up and across (in order to minimise error, the full width ($1\frac{3}{4}''$), and a vertical height of $\frac{7}{8}''$, were taken, and the oblique line scribed across the full width also), it was clamped to an angle plate bolted to the lathe cross slide, and carefully adjusted to the correct angle and height, sighting from the running centre, as before. To avoid the possibility of cutting into the angle plate during the drilling and milling operations, the work was backed with a piece of 3/16" three-ply, which also served to improve the grip of the clamping dogs.

Before shaping the upper edge of the slide, the supporting plate was roughly shaped from $\frac{1}{8}''$ plate, and drilled 4 B.A. tapping size in all four places, then clamped to the vertical slide and used as a jig for drilling the latter. The two were then bolted together in contact, and set up on the faceplate for machining out the curve between the horns of the roller pivot lugs, after which the tips of the latter were rounded off by filing. (Those who wish to carry the principle of " machining wherever possible " to its ultimate conclusion, might perform this operation by circular milling but the small size of the pivot which could be fitted to the holes makes this rather difficult.)



Filing a hexagonal cap nut with the aid of the filing rest.

It will be noted that the vertical slide extends below the level of the angle bracket at all positions of elevation, which thus necessitates setting the appliance on the cross slide with the vertical slide overhanging its edge. This may in some cases be considered a disadvantage, but is more or less inevitable, in view of the small amount of vertical room available. It might be avoided, in some positions of elevation, by making the vertical slide shorter, but this would reduce the bearing surface of the slide when it is at the extreme top, and is therefore undesirable. Actually, I consider that the overhanging slide is an advantage, as it allows the slide to be butted against the cross slide and thus ensures that it is square across the centres—that is, if the edge of the cross slide is square.

The slide must be fitted between the slide cheeks and retaining plates so that it slides freely, but without play. It is more than likely that the thickness of the cheeks will be insufficient to provide the necessary working clearance, and if so, thin metal foil shims may be fitted between the cheeks and the angle bracket or retaining plate, in preference to reducing the thickness of the vertical slide.

Lead Screw

It is advisable to turn this between centres and screwcut it in the approved machine shop manner. The use of dies is not recommended, as even with all the care in the world, it is not easy to avoid stripping the tops of the threads in places, and apart from this a long thread cut with dies is very rarely true to pitch throughout its entire length, and may even be " drunken " (inconstant in pitch angle throughout its complete revo-

* *Continued from page* 716, *Vol.* 81, "*M.E.*", *December* 28, 1939.

lution) or eccentric. For this reason, the extra time involved in setting up change wheels, etc., is well worth while. Accuracy of size should be carefully observed in the bearing portions at the two ends. If desired, the front journal may be modified to provide an improved fixing for the knurled head, by squaring the end (to fit an internal square in the boss of the head), and drilling and tapping it for a retaining screw. The method of fixing shown, however, by pressing on and pinning, works quite well and is much simpler. It is advisable to leave about ⅛″ extra length on this end of the screw when turning it, to allow of eliminating the centre and finishing it off flush with the face of the head after the latter is fitted.

Eye Bolts

These are made from 3/32″ by ½″ flat bar, set up truly in the four jaw-chuck, turned down to 3/16″ and screwed 2 B.A. for a sufficient length to take the nut. It is advisable to skim over the sides of the head at the same setting, rounding them off as shown in the drawing, as this helps to ensure accuracy when making off the position of the bearing hole. The latter should be drilled as exactly central, both ways, as possible, and also dead square with the flat faces; it facilitates handling if the drilling is done before cutting the eye bolts off from the bar. Drill the holes undersize, and finish them with a reamer or D-bit, to avoid roughness or unaccuracy of the bearings.

Knurled Head

No particular comments are called for in the turning of this item, which is a quite straightforward job, turned at one setting from a piece of ¾″ round bar. The larger diameter should be just skimmed up to run truly, and either knurled, or serrated by a series of planing cuts around its edge, then parted off and reversed for facing up.

The indexing is done, while it is set up for facing, by means of a vee-thread tool laid on its side, with the point exactly on centre level. A 50-tooth change wheel is fitted to the mandrel, and a simple locking detent arranged on the quadrant; the wheel is, of course, indexed two tooth spaces at a time, to give 25 divisions on the head. The marks 5—10—15—20 may be either stamped or engraved, the latter being much the neater if one has the necessary skill, or is on good terms with someone who has.

The head is pressed on the shaft of the screw, after the eye bolt has been assembled, and no perceptible end play should be allowed when it is in place. (Note that the end location is between the shoulder of the screw and the boss of the head, and no end-location of the tail bearing is attempted.) A hole is drilled right through the boss and the shaft, to take either a small taper pin or a tight-fitting parallel pin, which should be made slightly longer than the diameter of the boss, and carefully rounded on the ends. The screw, with the head and one eye bolt in position, may be wrapped in a strip of aluminium or copper foil, and chucked for facing the end of the shaft flush with the head, as suggested above.

While it would be possible to fit a much simpler form of index than that shown, the advantage of having one which is quite rigid and cannot possibly become deranged in use will be evident. A vernier scale might be added to the index, but such a degree of precision is beyond that to which this simple tool can normally aspire. The curved edge of the scale can be machined by setting up a bar of 5/16″ flat steel on the faceplate and boring a ¾″ hole in it, then sawing and filing away the rest of the bar to leave the shape required. The zero mark may be engraved while the bar is thus set up, by using the vee point tool as before.

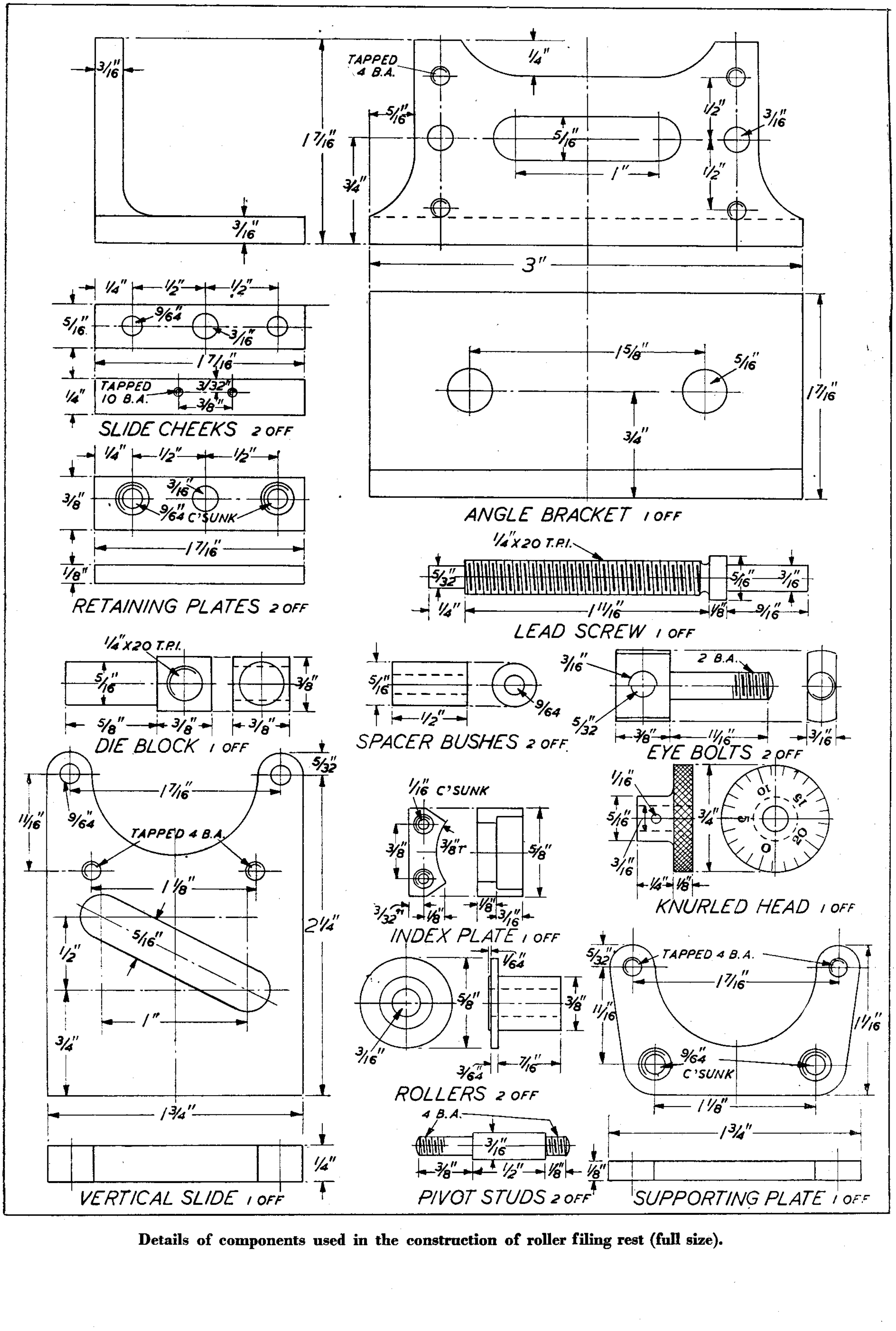
Die Block

Set up a length of ⅜″ square mild steel in the four-jaw chuck so as to run dead true over the corners, and turn it down to a tight push fit in the cross slots of the angle bracket and vertical slide. Cut off and face the bar to form a cubical head, then carefully mark it out centrally both ways for drilling the cross hole. If accurate drilling gear is not available, it will pay to set the job up in the four-jaw chuck, as it is most essential that the tapped hole should be perfectly square with the cylindrical part, and also intersect its centre exactly. It may be remarked that the use of rollers on the die block might reduce operating friction, but would almost certainly increase the accumulated clearance, and much the same applies to the use of flat-sided dies fitted to the slots; so that, as the amount of work which must be done by the die block is not very great, the solid cylindrical block is quite satisfactory. The die block, including the tapped portion, is finally case-hardened, and the cylindrical end polished.

Rollers and Pivot Studs

The rollers are each machined at one setting from ⅝″ bar, including the drilling and reaming of the centre holes. A sharp corner, or better still, a slight undercut, is advisable at the root of the side flange, and the cylindrical part of the roller must be dead parallel. After parting off to a little over length, the rollers should be set on a stub mandrel or chucked dead truly to face the other side, which should be relieved as shown, so that the edge of the flange is clear of the supporting plate. The rollers are finally hardened and polished.

It is advisable to use oversize material and machine the pivot studs throughout at one setting (except the screwing at one end), unless one possesses a true collet chuck, so as to ensure that the parts are truly concentric. The reason for tapping the supporting plate to take the short-end of the stud is to avoid the necessity for fitting nuts on this side, as this would increase the extent to which work would have to overhang from the chuck, in order to be operated on by the filing rest. On the other hand, the other ends of



Details of components used in the construction of roller filing rest (full size).

the studs are fitted to plain holes in the vertical slide, in order to eliminate any possible errors of squareness such as might be liable to occur if they were screwed.

The centre portions of the studs should be exactly the same length, and should just give the rollers running clearance when the parts are assembled; the spacing bushes, through which the countersunk screws in the lower edge of the supporting plate are inserted, should also be made to the same exact length. It may be noted that in some filing rests the roller pivots are only supported at one end, which is satisfactory for light work, but the addition of the supporting plate very much improves the rigidity, and eliminates spring under the heaviest working conditions.

Using the Filing Rest

The method of using the appliance, and its possible applications, are fairly obvious, but one or two notes on the subject will probably be helpful to less experienced readers. It should be noted that some form of indexing gear to the lathe mandrel is almost a necessary adjunct to it, and if nothing of this kind is fitted, it will be necessary to rig some such device as previously suggested, making use of the lathe change wheels as division plates. In my own case, I have fitted a small multi-row division plate, obtained some years ago from an advertiser in THE MODEL ENGINEER, with a spring blade index pin, and also a detent lever which can be adjusted to engage either the back-gear wheel, having 60 teeth, or shifted endwise to engage a change wheel mounted on the end of the mandrel in the usual way.

The job for which the filing rest is most commonly used is for shaping squares and hexagons on set screws, nuts, etc. While the use of bar material of the appropriate section is obviously advisable for the quick production of such parts, there are times when the exact size and shape required for an odd job are not immediately forthcoming, and it is then much better to expend five minutes or so in rigging the rest and shaping the work, than to postpone the job until the material can be obtained. In making small pressure fittings, such as gauge glasses, stop valves, glands, banjo or plain unions, etc., it is a great advantage to be sure that the hexagonal parts are exactly concentric with the threads, which they will be if the machining is done properly at one setting, and the filing rest is rigged and used before the work is removed from the chuck. In many such fittings, it is very desirable to make the joint face circular, and of larger diameter than the hexagon; in such cases, hexagonal material cannot be used, unless the rather doubtful practice of sweating or brazing on a collar is adopted, and the only alternative is to shape the hexagon after turning, which can be done quite easily by this means.

Chuck keys, or other forms of keys for mating with recessed screws, including the popular Allen set screws, are easily shaped by the aid of the filing rest. It may be mentioned that these items may with advantage be made of high tensile steel, and I have found that the tommy-bars supplied with sets of automobile box spanners is excellent material for this purpose. Case-hardened mild steel, or hardened and tempered tool steel, while much to be recommended, is a good deal weaker in torsion than a very tough nickel chrome or chrome-molybdenum steel.

The filing rest can also be used for the expeditious production of D-bits, which are sometimes a little difficult to measure up properly if they happen to be tapered or otherwise varied in diameter. In this case the rollers must be set exactly to the lathe centre height, which may be found by trial, and the setting of the micrometer noted. Alternatively, the rollers may be set level with the top of the work, as checked by laying a straight edge across the top, to make contact at all three points, and the rest then lowered by an amount exactly equal to half the diameter of the work. It should be pointed out that the rest should first of all be set to about 0.005″ higher than the final setting, for roughing down with a coarse file, and then re-set for finishing with a dead smooth file.

When making nuts to conform exactly with standard dimensions, so that they can be turned by standard spanners, it is advisable to proceed as follows: First turn the blank to the size of the nut over the corners, or very slightly over; it is advantageous to work fairly closely to size, as this dimension will form a check on the size over flats, when the latter are shaped. Assume, for instance, that a 2 B.A. nut is being made, the standard dimensions of which are 0.382″ over the corners, and 0.324″ over the flats. After turning the blank to 0.382″ dia., the rest is rigged, and the rollers set flush with the top of the work, as described above. The rest is then lowered by an amount equal to half the difference between the diameter over corners, and the diameter over flats, i.e., $382 - 324 = 58$; $58 \div 2 = 29$. The rest must thus be lowered 29-1,000ths of an inch, but it should be noted that this is the *final* setting, and the roughing down should be done at only about 24 or 25 "thous." lower than the flush setting.

One point is most important about the files used with the filing rest; in order to attain accuracy, it is pre-supposed that the working face of the file is dead straight and flat. This is not, however, true in all cases, as a good many files are "bellied," and others may be ostensibly straight, but in reality warped and distorted. The effects of such discrepancies are not likely to be serious for the files used in roughing operations, but a really true file should be used for finishing, and a good quality Swiss file is to be recommended. All files should have a safe edge, which is kept pressed against the flange of the rollers when in use; if the other edge is against the rollers, it will not affect the work, but is liable to wear the file, as a

certain amount of skidding is bound to take place.

A certain amount of practice is necessary to get the best results with the filing rest, as the file will skid badly if it is not held down in perfect contact with the work or the rollers, and of course, when it rests fairly on the latter, will entirely cease to cut. In this respect, it may help the beginner to learn how to file flat, when using the file in the ordinary way.

Apart from the simpler uses of the filing rest, it can be very effectively used for a number of other operations which present great difficulties in the ordinary way. In the making of tangential cams, for instance, the filing rest is as useful as and much simpler to operate than, an elaborately-equipped milling attachment; but space does not permit dealing with this and other possible applications of the appliance at present.

Bargains in Motor Accessories

MESSRS. A. W. GAMAGE, LTD., Holborn, London, E.C.1, have submitted for our inspection samples of surplus motor accessories, as advertised by them in the "M.E." These are all brand new and in perfect condition, and the prices at which they are offered are so low that, quite apart from their usefulness as spares in their originally designed purpose, they also suggest many possibilities for conversion or adaptation.

The first of these items is a complete motor car dashboard panel, comprising virtually four instruments: a speedometer, an eight-day clock, an ammeter and a petrol-tank gauge, the two latter being combined in one dial. In addition, two indicator lamps, for the ignition circuit and oil pump tell-tale respectively, are fitted to the panel, and the tank unit of the petrol gauge is also supplied. Examination of the individual instruments discloses that the speedometer is of the magnetic type, and is readily convertible into a tachometer for use in bench testing, also the two counters could be removed, and would find many uses in testing, coil winding, etc. The clock unit calls for no special comment in respect of either its quality or utility, except to mention that the A.C. motor car clocks have a very good reputation for timekeeping and reliability, and the sample examined was found to be in proper going order.

The ammeter is of the polarised type, recording charge or discharge up to 20 amps., and the petrol gauge, which is of the electrical type, is adaptable to most tanks of approximately the appropriate depth and will record at practically any distance.

An entirely separate petrol tank gauge, having a similar tank unit, but with a single dial gauge, is also supplied. It may be remarked that these instruments have an ingenious electrical motion which may readily be adapted to any purpose requiring a remote indicator or "repeater." The tank unit, which may be regarded as the transmitter, embodies a small variable rheostat or potentiometer controlled by the float arm, and the dial gauge, or receiver, has a pointer which is magnetically controlled by two electro-magnets, one working at constant potential, and the other at a variable potential, as controlled by the rheostat. Such a device will "repeat" the motion of the float arm at any reasonable distance, and is unaffected by moderate variations of the supply voltage, as the receiver is controlled by the proportionate difference in the strength of the two electro-magnets.

A speedometer, having a similar motion to that fitted to the dashboard panel, is also supplied separately. This has a 5" dial, and incorporates also an 8-day clock.

The A.C. petrol pumps which feature in this list of items are of a type familiar to all readers with motoring experience. They are of the diaphragm type, intended to bolt against the crankcase of the engine and work off the camshaft; a bell crank lever with a hardened pad or cam follower being fitted for this purpose. The linkage to the diaphragm is so arranged that the pump will operate up to a certain maximum pressure, above which the diaphragm is put out of action. An integral filter, with glass sediment bowl, is also incorporated. This pump is obviously adaptable to a wide variety of purposes, and is very easily fitted up to work off any rotating shaft.

Other useful items in this selection include oil pressure gauges, reading up to 60 lb., and suitable also for air, water or steam pressure, providing that in the latter case they are equipped with the usual syphon tube to protect them from high temperature; also 6' lengths of flexible shafting (inner and outer members) which have a wide range of utility in the amateur workshop for driving grinding and milling spindles or similar attachments.

Gamages are also offering a very interesting line in small geared a.c. induction motors, rated at 12 to 14 volts, having a rotor speed of 2,000 r.p.m. and a final shaft speed of 58 r.p.m. They are equipped with an overload clutch, a thermal cut-out, and also reversing contacts, and appear to have been intended for the operation of remote or automatic control gear. Their possibilities in this capacity are almost unlimited, and some of the uses that we suggest that model engineers may be able to find for them include the automatic operation of switching or signal gear, drawbridges, lock gates, etc., on model railways; tuning or selector gear on wireless apparatus; advertising and display devices, etc. Another very practical use for a slow-speed geared motor of this type is the driving of a small air pump or bellows for aerating an aquarium, a function which this motor performs quite reliably, the current being supplied from the mains through a 12 volt bell transformer.

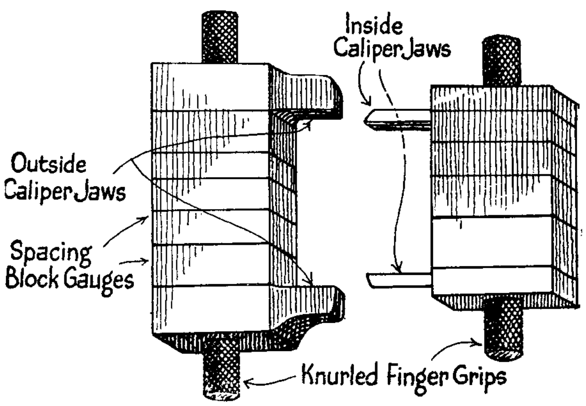
*Gauges and Gauging

A series of great value to engineers of all classes, particularly those who are engaged upon national service

By R. Barnard Way

MUCH has been written so far, and much remains to be dealt with, on the subject of gauges capable of testing the dimensions of machined products to limits in the order of thousandths of an inch. We think that some useful digression might be made here to look at the work of the tool-room where these gauges will usually be made. Some firms prefer to have them made by outside concerns whose business is gauge-making, but it will, sooner or later, be an imperative necessity to have them made "at home," so to speak, if a full limit gauging system is to be set up.

Let us first examine the tools used. It must be said at once that these do not differ from those employed by any careful skilled workman, but there are some that will not usually be found in the open workshop. They will all be in first-class condition, and machine tools especially so. The tool-room lathes are, as a rule, built for the class of work, with refinements not applied to the normal workshop lathe. The tool-room has to be able to produce work to a degree of accuracy at least one hundred times that of the shops outside. The master gauges to which all final reference is made, will be even more accurate than this. These will be made by people who specialise in their manufacture, as will also the measuring machine and all the subsidiary micrometer gauges.



Gauge blocks assembled to make outside and inside calipers.

With the work of the machine tools we are not immediately concerned, but the other things we are, so let us begin.

We have seen that the National Standard in Great Britain has been handed down to us through the ages, beginning with the placing together of barley corns, end to end. Passing through various stages, it now exists in the form of a number of bronze bars, only one of which normally records an exact yard, though the deviation of the others is very precisely known. There is no difficulty in making their lengths a true yard, whenever it becomes necessary.

This measurement has been very exactly reproduced on to metal bars of a more certain quality, so that it may be truthfully stated that the Standard Yard is more enduringly recorded now than ever before.

The Steel Rule

When the apprentice buys his first steel rule, if he gets a good one, he has acquired something with a pedigree behind it. It will record twelve inches with a remarkable precision, and when tried out under conditions equivalent to those that prevailed when it was made, will be found correct within the thousandth part of an inch. Measurements can be made with very reasonable accuracy to the hundredth of an inch by eye, and by using a magnifying glass this 0.01″ can very well be improved to 0.002″, if the light is good and the rule clean and well kept. In this respect, the stainless steel rule is a very good investment. The graduations are always etched in, and careful readings depend upon the thickness of the lines, which ought not to exceed 0.003″ in width. A rule intended for a greater degree of accuracy than the usual mechanic's twelve-inch will have its graduations marked with finer lines than this. Later, we shall come across graduations of such a degree of fineness that they are invisible to the unaided eye, being designed to be read only by means of a microscope.

The normal rule can be used with every confidence for setting the gauging calipers in ordinary workshop practice, but it cannot give the necessary precision for the making of gauges, or at least, for the finishing of them.

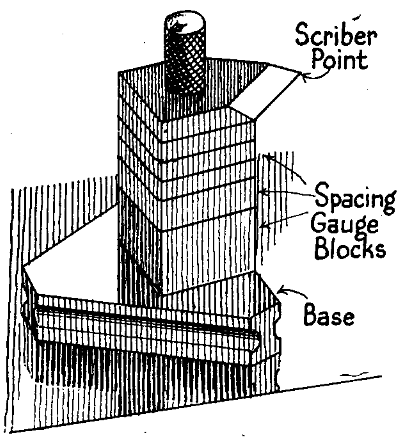
The Steel Tape

The steel tape is an essential aid to exact measurement, where shafts and cylinders are concerned, but there are some pitfalls in its use. The usual length of a tape is 100 feet, with a section of $\frac{3}{8}$″ by 0.02″, and a good one will have bright figures in relief on a black ground. To ensure true readings, the tape must be pulled tight, and a tension of at least 10 pounds ought to be applied.

A tape is invaluable for measuring the diameter

* *Continued from page* 680, *Vol.* 81, "*M.E.*," *December* 21, 1939.

of large shafts and drums, in such cases the circumference is always taken, but unless great care is used to ensure the tape lying perfectly true and flat, errors will arise. Moreover, if the final measurement is taken with the two ends of the tape side by side, the true course is not a circular one but helical, and so a slight increase of circumference will be recorded. Halving the tape halves the error, which in any case will not be serious. What is more important is the error due to the thickness of the tape, and this, on any



A gauge block assembly to make a scriber block.

circular measurement however small, will amount to almost exactly 1/16″ with a tape thickness of 0.02″. Such an error might well be disastrous in small work, though in large work it might not be so considerable. The error is there, and the reading will be 1/16″ over the correct one, so must be deducted. For small work, calipers can be used to measure diameters, but for cylinders or rotor drums up to 30 inches or more in diameter callipers will be unwieldy though they are used.

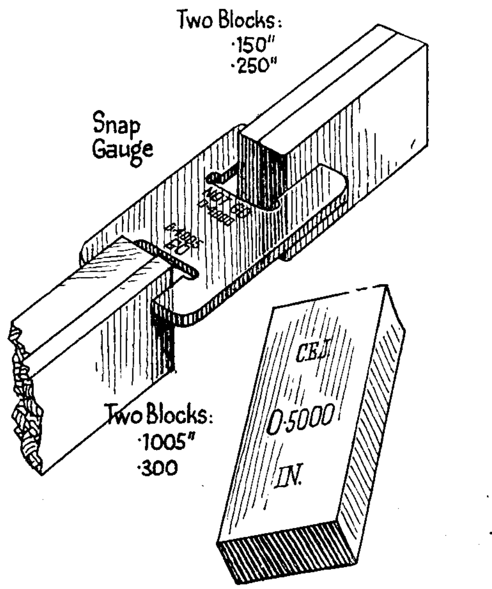
A very useful type of scale, often seen in the drawing office and elsewhere, is engraved by a photographic process into the surface of a plate of glass. It is an ingenious process, for there is no film left after the figures and lines are fixed, and these have a metallic lustre. Graduations are carried to 0.005″. Very exact measurements can be made, as the glass is designed to be laid flat on the work, so that no errors of reading are possible through looking obliquely.

Not many men have sight keen enough to enable them to read off the 64ths, let alone the 100ths, on even the best kept steel rules. For such purposes, if you have to read these graduations, a watchmaker's eyeglass is useful, as it can be held in the eye quite easily, and leaves both hands free for holding the work and rule.

The Wedge Type Gauge

A useful gauge is the wedge type, usually made in sets, covering a full range of thicknesses from 0.01″ to 0.50″. Each one is a very exactly formed taper wedge, and on its face are graduations recording the thickness at that particular point; the taper is a fine one, the thinnest covers a range from 0.01″ to 0.15″.

One of the prime essentials in the tool-room is the surface-plate, and next to that the straight edge and the square. Until a workman can finish off a plate absolutely truly square, he will never be a tool-room hand. Whitworth, the father of all accurate standards of workmanship, realised this, and the surface plate is his idea. They can be had in sizes from 3″ square up to 10′, and are made in sets of three together. The castings are roughly machined and then left to season for a year or so; this process can be hastened somewhat by vibration, but it is probable that time does the job better. The surfaces of two are placed in contact, one above the other, and an abrasive spread between them. Continuous motion about and about, avoiding repetition, gradually reduces the high spots on each pair, until an approximately flat surface is obtained. This has to be carried out with all three plates, two at a time, for in this way it is assured that no two develop concave and convex surfaces that agree. Smearing a colour, prussian blue usually, upon the surfaces and working them together shows up the high spots, if there are any, and these can be reduced by hand scraping. The final work will be by abrasion.



Testing a snap gauge with gauge blocks.

The Toolmaker's Flat

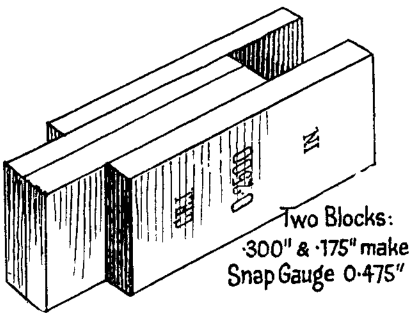
For the highest class of work, the toolmaker's flat will be necessary. This is a circular disc of chrome steel, with a diameter of 5″, and a thickness of $\frac{7}{8}$″, the two faces are parallel to within 0.00001″. We shall see some applications of this shortly.

Final testing is by means of the optical flat, a glass disc finished to possibly an even greater

degree than the toolmaker's flat. When a surface to be tested is brought as close as possible, without a wringing contact being made, to the optical flat, a curious effect of rainbow bands of colour is seen. The bands will be in definitely orderly form, and are due to optical interference in the extremely thin air gap between the surfaces. If the effect is viewed in red or blue light the bands are seen in dark grey, which makes them easier to judge. Further details of this method of testing will be given later when dealing with optical methods.

The Block Gauge

While we are on the subject of surfaces, the time seems opportune to introduce one of the most remarkable aids to accurate work and measurement, the Block Gauge. First produced, we believe, by the Swedish firm of Johansson, the block gauge is a rectangular piece of steel of specified measurements that conforms to those dimensions as nearly as human workmanship can



A temporary snap gauge assembled from gauge blocks.

make it. There are many different sizes in a set, for, of course, one block would not be of much use by itself. A full set comprises 81 blocks. Their thicknesses range from 0.1000″ to 0.1009″, rising by 0.0001″, then from 0.101″ to 0.150″ by 0.001″ increases. There is also a block measuring 0.050″. From 0.150″ up to 1″ the increases are by 0.050″, and finally there are blocks of 2″, 3″ and 4″.

In addition to these, caliper blocks are to be had, so that extremely accurate inside and outside gauges can be made, as well as height gauges and a number of other useful arrangements. Some of these we show here. American gauge blocks of similar type provide a centrally drilled hole so that tie-rods can be run through a completed assembly.

The finish of these blocks is put on by hand lapping, though the method has not been disclosed. Other firms make them now, but the Johansson gauge is still, we believe, the acknowledged master. It is the one that the writer has had experience with, and coming to them for the first time is a notable event for anyone with an admiration for fine workmanship. The surfaces are so perfect that one block will wring on to another simply by means of a slight pressure and twisting movement, and will remain so until separated by a reversal of the process of joining. Any number of the blocks can be thus wrung together to make up a stick.

The Non-existent Gap !

This is remarkable enough, but there is more to come. So minute is the gap between one block and the next that it can be said that it is non-existent. Proof of this is immediately forthcoming if an accurate measuring machine is available, for if the thicknesses of the wrung blocks are added up the measuring machine will record that total with exactitude. Scientists believe that the contact of one block with the other brings into play the attraction of molecule for molecule, assisted by the absence of any intervening air-gap. Be that as it may, the blocks hold together so that no ordinary force can separate them, except by the twisting movement, when it is easily done.

It should be at once apparent that such a system can be invaluable, because by building up an assembly of the blocks almost any dimension can be absolutely established. We shall see a good many uses for these gauges before we are finished; we have already mentioned them on several occasions, so that some explanation has been overdue for the benefit of those who have not met them before.

Work out on paper first

Suppose, for instance, that a dimension of 3.1416″ has to be set up. This can be done in a variety of ways, one way might use more blocks than another, but all of them will measure up correctly. We could do it first of all by starting off with 2″, 0.800″, 0.140″, 0.101″, finishing up with 0.1006″, total 3.1416″. Alternatively, the same total can be made up with 1″, 0.900″, 0.600″, 0.200″, 0.130″, 0.111″, 0.1005″, and 0.1001″. This has the advantage of avoiding the use of any of the blocks employed in the first assembly. A good many alternative sets can be made up to the same total out of the remaining equipment. The best way to work out an assembly is to go about it on paper first, basing it upon subtraction from the original total specified, thus our first assembly is got out in this way:—

$$
\begin{array}{l}
3.1416 \\
0.1006\ - \\
\hline
3.0410 \\
0.101\ \ - \\
\hline
2.9400 \\
0.140\ \ - \\
\hline
2.8000 \\
0.800\ \ - \\
\hline
2.0000 \\
2.00\ \ \ - \\
\hline
\end{array}
$$

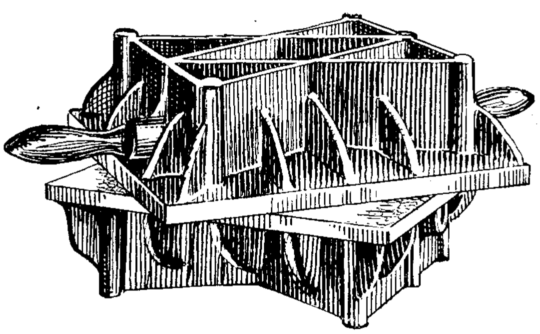
The gauges are guaranteed to be accurate to 0.00001″ *per inch,* this is important, for they are made to be correct at a fixed temperature, usually 62° Fahr., and this accuracy figure represents the co-efficient of expansion per degree rise of temperature. Conversely, the same degree of contraction takes place in a falling temperature. In consequence, if the purchaser of a set of such blocks is going to use them seriously he will have to arrange for a perfectly controlled temperature to be maintained in his gauging room. The advantage of the centrally-bored American gauges is seen when handling an assembly, for the ends of the centring rods can be used as handles, and so the heat of the hands does not pass to the blocks.

These gauges will wring on to surface plates, such as the toolmaker's flats already mentioned, but not on to an ordinary surface plate. They provide such an exceptional accuracy standard that it becomes necessary when using them to employ only apparatus giving an approximately equal standard.

Lapping

A few notes on the subject of lapping, the final process by which these blocks, and all other precision gauges, are finished, will, perhaps, be opportune here.

The machining process will be fine grinding, and this will be carried down to within 0.0002″ of the finished size. Though grinding can produce a beautiful mirror-like surface, or what looks like it to the naked eye, examination under a microscope shows the surface in reality to be scored

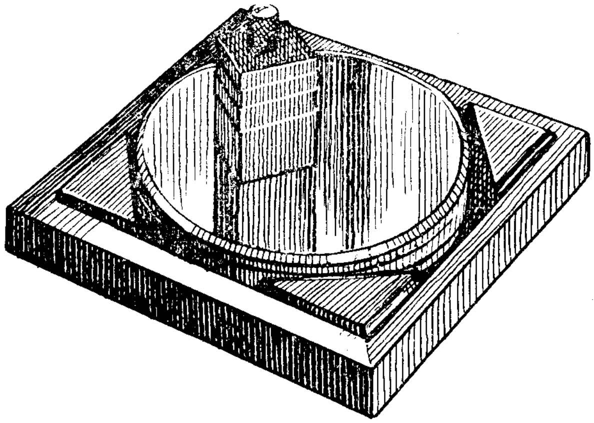


Surface plates.

with fine lines and high spots, as might be expected. It is the purpose of lapping to reduce these scorings, and so reduce the friction between gauges and work. In other fields of engineering this is realised, and the use of burnishing processes effects the same result.

Not Emery Cloth

Emery is generally preferred for lapping, but *not* emery cloth, please! This is often done, but it is not a good idea at all. The emery used is the finest grade deposited in oil and allowed to settle for some hours. The oil is decanted off, carrying with it the finer particles still in suspension, and these are allowed to settle also. After subsequent decanting and settlement, the residue is considered to be sufficiently fine, as indeed it is.



A toolmaker's flat with gauge blocks wrung on.

The lapping plate will be either soft steel or cast-iron, and on this the abrasive will be spread, emery in lard or whale oil, though in some places carborundum in vaseline, 1 part to 8 parts, is preferred. For slow lapping, to produce a super finish, rouge will be used. The great art in lapping is to keep the motion of the piece being lapped truly in the same plane, not easy to do when it is the small surface of the jaw of a snap-gauge, for instance. The difficulty is a real one, as you can soon discover for yourself. Frequent testing is advisable. Every time this is done, the abrasive must be thoroughly washed off with petrol, and the gauge brought to the room temperature by immersing it in a bucket of water that has stood there long enough to ensure that its temperature is the same. This, as we have already said, should be as nearly 62° Fahr. as possible.

Uses of Block Gauges

Reverting to the subject of the block gauge once more, our sketches illustrate a few uses for these invaluable aids. The American block gauges with their caliper jaw attachments are shown, and also the scriber pointed block that enables you to employ the set in the absence of an ordinary scribing block.

A quickly assembled snap gauge for a quick job can be assembled, as shown, out of four pieces; the two inside pieces total the amount to be gauged, while the two outer ones can be any blocks of reasonable thickness. Note, also, the method of using them for testing the accuracy of an ordinary workshop snap gauge.

We shall have more acquaintance with these gauges very shortly.

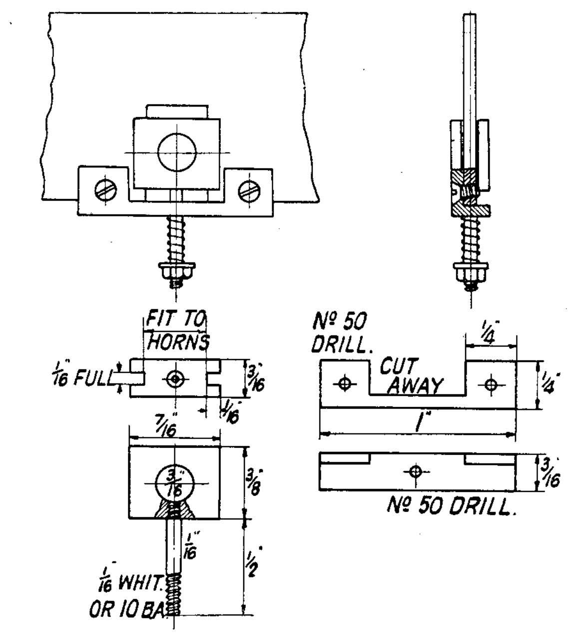
(To be continued)

The "Bat"

By "L.B.S.C."

Axleboxes

AS we are using extra thick frames and dispensing with hornblocks, the axleboxes merely consist of small pieces of rectangular brass rod with a groove at each side, and a single spring-pin at the bottom. To allow for chucking, get a piece of 7/16″ by 3/16″ rod, about $2\frac{1}{2}$″ long. In the centre of the narrow sides, plane, mill or saw and file a groove 1/16″ wide and deep. If a milling machine, or one of those handy little shapers on the market, are not available, the job can be done on the lathe by mounting a small machine vice on the saddle, and gripping the piece of rod in it at the correct height. It is then run under a 1/16″ slotting cutter mounted on a spindle. If you have not a machine vice, use two bits of angle steel bolted together, as illustrated for the screw-head slotting jig recently illustrated in my munition-shop reminiscences. If your lathe has no saddle, make a parting-tool 1/16″ full width out of a bit of round silver-steel. Hold it in the three-jaw, with the cutting edge towards you. Put the axlebox blank under the lathe tool-holder at right-angles to the lathe bed, packing it up to correct height, and traverse it across the tool with the cross-slide, feeding into cut with the top-slide. There are more ways of killing a cat than hanging it—only if your humble servant caught anybody trying to eradicate a cat there would be a more blitzy blitzkrieg than ever Uncle Adolf imagined in his wildest dreams! Chuck the grooved blank, and part off four $\frac{3}{8}$″ lengths.



Axlebox and hornstay for coupled wheels.

As with the bigger engines, the boxes should slide freely with no fore-and-aft movement; but the flanges being double, the slots should be wide enough to allow the boxes to tilt a little. Fit each box to its slot, and mark them 1 and 2 (left-hand or "platform" side) and 3 and 4 (right-hand or "six-foot" side). Mark off and drill 3/16″ clearing holes in the middle of 1 and 2, and use as jigs to drill the others. Then, if the holes first drilled happen to be a little "out"—tyros please take note—the opposite boxes will be "out" to an equal amount. The old saw says that "two wrongs do not make a right"; well, they do in this case, as the axles will still lie square across the frame, and the slight alteration in the length of coupled wheelbase does not matter a bean.

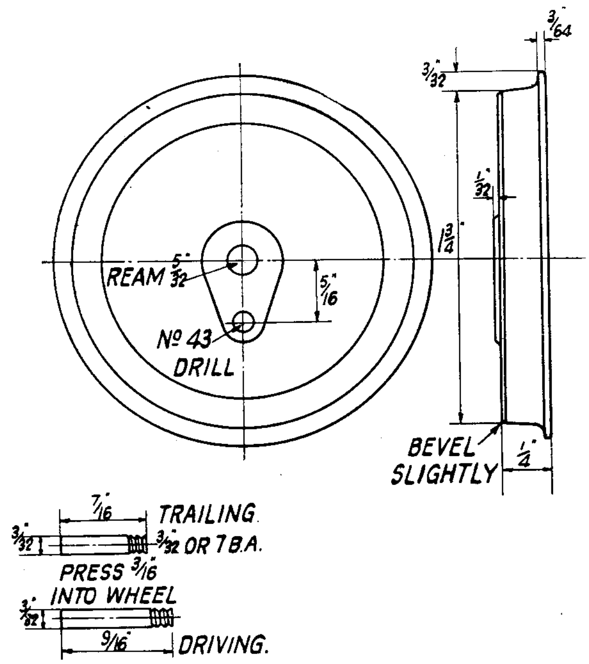
The hornstays are merely bits of $\frac{1}{4}$″ by 3/16″ by 1/16″ angle, attached to the frames by 10 B.A. or 1/16″ countersunk screws. The centre part is cut away to let the axleboxes have the full amount of up-and-down movement. It does not matter whether they are fitted inside or outside the frames. Put the axleboxes in place, then the hornstays; run the No. 50 drill through the hole in hornstay, and make a countersink in the axlebox. Have the box jammed tight against the hornstay, with a wedge at the top, whilst doing this. Follow up with No. 55, tap 1/16″ or 10 B.A., and screw in the spring-pins. These are made from 16 gauge spoke wire, or 1/16″ silver-steel. The springs are wound up from 26 gauge tinned steel wire, and secured by ordinary commercial nuts and washers. Put a bit of packing, 1/16″ thick, between hornstay and axlebox, and tighten up the spring-pin nuts to hold the boxes in running position whilst the motion is erected.

Coupled Wheels and Axles

The size of coupled wheels should be $1\frac{3}{4}$″ diam., but if the castings will not clean up to this there is no cause for alarm, a little undersize will make no difference at all to "the works," and only means bringing the buffer-beam a shade nearer the rails. Be careful to get width and depth of flange right. Unfortunately, as all followers of these notes know full well, Nature cannot be scaled, and if we turn the wheels with weeny-weeny flanges, they may look very pretty, but will not stay on the road, unless the said road is absolutely perfect, and the speed kept down to "scale" or equivalent. Most readers just delight in seeing a little engine travelling like a bat out of (sorry, must not give information away to the

enemy!), and the average portable track is, more often than not, like the famous Russian line that goes up and down Steppes. In order to combine speed with safety, even with sprung axles, we need the same depth of flange on an "0" gauge engine as on one twice the size.

These small wheels are turned the same as described for larger engines, viz., first chuck in the three-jaw, gripping by the tread. Face the



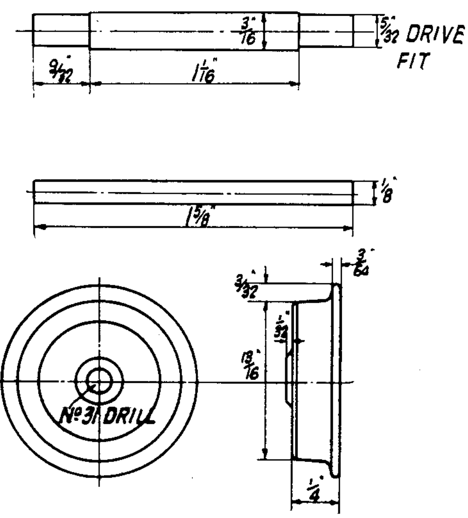
Coupled wheel and crankpins.

back and boss, centre, drill No. 24 and ream 5/32". Reverse, and turn front of rim; face boss. Chuck an odd wheel casting or disc of metal about 1¾" diameter. Face, recess the middle part slightly, centre, drill and tap 3/16", and screw in a stub of steel rod. Turn down until the wheels slide on easily without shake. Screw the end and fit a nut. Put each wheel, face outwards, on the peg, tighten the nut, and rough-turn with a round-nose tool, made by grinding off the end of a pointed tool, to about ⅛" radius. When the last one is on the improvised faceplate, re-grind the tool, and turn to the finished size. Without shifting the cross-slide, finish-turn the other three, and they will be all the same size without need of measuring. Round off the tips of the flanges with a fine file.

There is no need to make a special jig for drilling the crankpin holes. Mark off one wheel and drill the crankpin hole No. 43, then use it as a jig to drill the others, by laying it on top of the wheel to be drilled. Poke a bit of 5/32" rod through the holes in the bosses, line up the tails of the "pears" by eye, and use the 43 hole in the upper wheel to guide the drill through the lower one.

The crankpins do not need any turning. They are plain lengths of 3/32" silver-steel or 13 gauge spoke wire, with 3/32" of thread on one end. Put a nut on the screwed part to protect the threads, and squeeze the plain end into the No. 43 hole in the wheel boss, so that the amount shown in the sketch sticks out beyond the face of the boss. Use the bench vice for the squeezing operation; but if it has the usual serrated jaws, put brass clams over them. I found that pieces of angle brass about 1½" by ⅛" make excellent clams for small jobs, gripping well without marking.

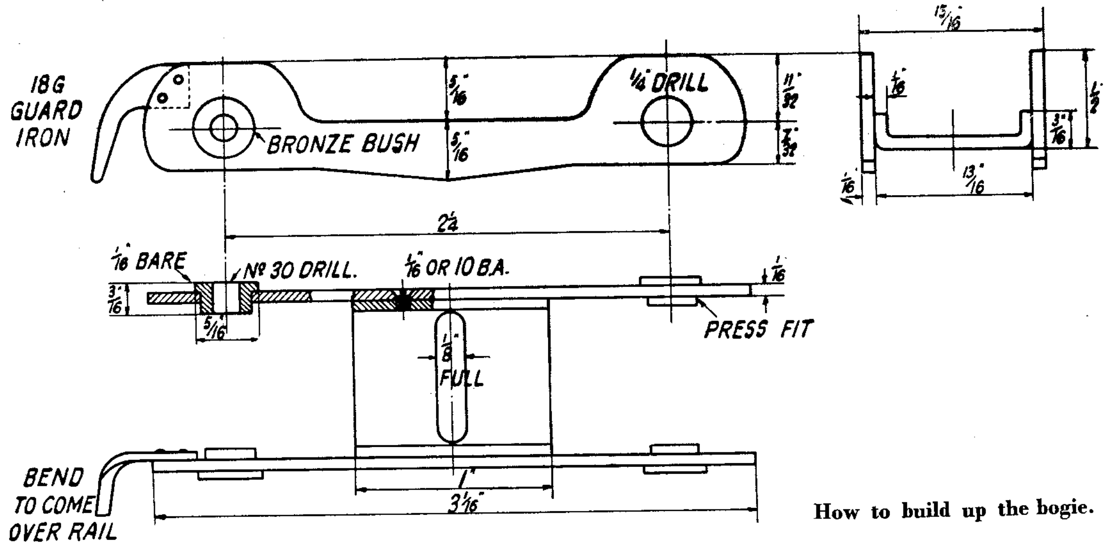
The axles are turned from 3/16" round mild steel, to dimensions as sketch. Grip the steel in the three-jaw; if it does not run true, pack between axle and offending jaw, with paper or foil. I have got into no end of trouble with Inspector Meticulous and his retinue, by recommending that the last thousandth or two, should be taken off the wheel seat with a fine file, so as to obtain a correct driving or force fit; but the stubborn fact remains that the vast majority of tyro lathe users find that if they endeavour to turn the seating to the force fit, they either have it too tight and split the wheel boss, or too loose and the wheel comes off. Also, many small lathes do not turn parallel. Squeeze one wheel only on to each axle for the time being. The eccentrics and stop-collars must be made and fitted to the driving axle before pressing on and quartering the second wheel.



Bogie wheel and axle.

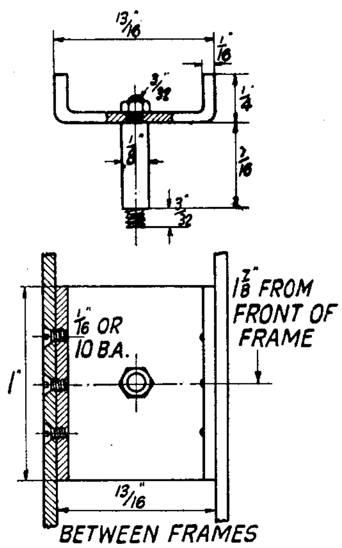
Bogie

Unless the builder is particularly fond of watch-making jobs—your humble servant is not!—there is no need to fit a fully-sprung and equalised bogie. A plain four-wheeled rigid-framed truck with a central spring, will hold the road at high speed, carry its share of the engine, and look sufficiently Southern-like to satisfy most good



How to build up the bogie.

folk. The bolster is a piece of 16 gauge frame steel, 1" wide and 1 5/16" long; $\frac{1}{4}$" of this is bent up to a right-angle at each end, so that the distance over angles is 13/16" and fits between the main frames at the leading end. A 3/32" hole is drilled in the middle, for the bogie-pin. This is turned from $\frac{1}{8}$" round steel, as sketch, shouldered down at each end, and screwed 3/32" or 7 B.A. The whole doings is attached to the frames by 1/16" or 10 B.A. screws at each side, through the No. 50 holes in the frame.



Bogie bolster.

The bogie side frames are cut from 1/16" steel, as sketch, sawing and filing to shape, and drilling the holes, with the plates temporarily riveted together as described for main frames. The holes for axles should be drilled $\frac{1}{4}$", and little bronze bushes, as shown, turned to fit. They should be a tight press fit, with the flanges outside. The centre-plate, or stretcher, is made and fitted exactly the same way as the bolster on the engine frames. It has a slot cut in it, to clear the bogie-pin, and allow for side movement of the bogie on curves.

The bogie wheels are 13/16" diameter on tread, with deep flanges same as the driving wheels, and are turned in exactly the same way. The axles need no turning at all, round mild steel or silver-steel of $\frac{1}{8}$" diameter being used. If the holes in the wheels are drilled undersize, say 7/64", and then opened out with a No. 31 drill, the wheels will press on to the axles a nice tight fit without any danger of splitting the bosses.

Before mounting the wheels on the bogie, cut out two guard irons from 18 gauge steel, soft for preference, and rivet them by a couple of 1/16" brass rivets in each, to the front ends of the bogie frames, as shown in the sketch. These guard irons are bent, after the wheels are fitted, so as to stand exactly parallel with the centre of the corresponding wheel tread, and trimmed off at the bottom, to clear the railhead by about 3/32". Press one bogie wheel on each axle, poke the latter through the two bronze bushes in the bogie frames, and then press the other wheel on. As there are no steps or shoulders to press the wheels home against, be careful of your gauge measurements. If the wheels have been correctly turned to width, and the axle cut to dead length, the distance between the flange backs should be an inch and a sixteenth. I have written that out in full, as it is most important!

A spring, made by winding a bit of 24 gauge tinned steel wire around a piece of $\frac{1}{8}$" rod held in the chuck, is placed on the bogie pin. It should be about $\frac{3}{8}$" long when fully extended. Place a $\frac{1}{8}$" washer on the end, then put on the bogie, and a 3/32" nut and washer on the end of the pin will make all secure.

Practical Letters

Small Motor Cars

DEAR SIR,—On the front cover of the December 14th issue of the "M.E.," I see a photograph of a small car which is stated to have "been made for a man," to take him to work. I feel certain that the small car seen is the production of the Birmingham firm, Chas. H. Pugh, Ltd., the makers of the "Atco" motor lawn mower, and this car is a commercial production which is on sale to anyone who care to purchase one. It is named "The Atco Junior Safety First Trainer," and was originally introduced with the object of training children's road sense, its price being between £30 and £40.

It is, of course, possible that some modifications may have been made to the car as originally purchased, but the fact still remains that the car is (I believe) the model above mentioned. I have had many of them through my hands, and my reason for writing is that I think that the enterprising firm who produced it should have credit for doing so, instead of awarding the credit to any individual who cares to claim it.

As a matter of interest, you may care to know that the little car is powered with a 2-stroke engine, has forward and reverse gears, and hand and foot brakes. It is perfectly capable of carrying an adult and a child, though both are, perhaps, a bit cramped.

Yours faithfully,

Manchester. A. WOOD.

Model Locomotive Performance

DEAR SIR,—Your editorial in the "M.E." for November 30th expresses an opinion that tests carried out by the Romford and possibly other clubs opens up an opportunity for an investigation into the performance of model locos. in general.

With this I am in entire agreement, and made suggestions with this end in view some years ago in the "M.E." Some of your statements cannot, however, be allowed to pass without comment, the one that the performance of model locomotives is "*far beyond anything even remotely approached by full-size locomotives,*" is, to say the least, mistaken and incorrect. Given places of prominence in editorial columns, such statements are apt to become recognised as facts, but I assure you, Sir, that in this case nothing could be further from the truth.

I have no idea how or on what evidence your wording was based, but it appears that some error must have entered into any reasoning. Taking speed, for instance, 7 m.p.h. mentioned for the model round curves of about 68.7 ft. radius (maximum), it was stated, corresponded with a speed of 168 m.p.h. for the full-size. In analysing these figures, 69 ft. represents a curve of 23.4 chains, the maximum speed for the prototype, with cant of 3″ ($\frac{1}{8}$″ scale), would be slightly over 33 m.p.h.

Not at the moment wishing to enter upon a discussion regarding speeds, another and more correct method of comparison gives the speed for the prototype of 33.3 m.p.h., not 168—a considerable difference.

Further, for some years I have been, on and off, testing model locos. and boilers, with or without engines, and can definitely say that I have never obtained anything like the efficiency of the prototype. My highest efficiency has been obtained with my latest model—a Yarrow type marine boiler with oil fuel burner—giving a figure of 44% on short period complete evaporation tests. So far as the generator is concerned, this is approximately one-half the efficiency of the full-size boiler.

With model locomotives, both with my own crude efforts and from figures given in past years in the "M.E.," the overall thermal efficiency is approximately one-tenth that of the prototype. With steam consumption, the same occurs; anything from 100 to 200 lb. of steam per 1 h.p. being necessary, comparing unfavourably with the 20 to 30 lb. of the larger engine; and again, with model marine engines, the minimum I have recorded is about 55 to 60 lb., as against the 15 to 30 lb. of the various prototypes.

Many statements made appear to be based on incorrect assumptions, and to accord with the large loads hauled by models, I had for some time the opinion that efficiencies were generally higher. Since then, after a fair amount of work, I can say definitely that all models are amenable to the normal methods of calculation, provided that certain factors are used in order to bring about a correct comparison, and taking any design of model locomotive, its performance on the track can be assessed with a degree of certainty that is surprising.

Kindly excuse the length of this letter, but I may plead the complexity of the subject.

Yours faithfully,

Manchester. "JOS."

[Our correspondent appears to have missed the point of Mr. Maskelyne's remark. The "Henderson" contest at Romford has afforded an opportunity for the collection of valuable data relating to the performance of model locomotives on the track, and the longer the contest is continued the greater will be the amount of information obtained. This *observed* data, when properly sorted and categorically arranged, should then be compared with the results obtained from the various methods of *calculating* performance. By this means, the degree of accuracy of the many theoretical computations of model locomotive performance can be tested; at present there are too many of them, and they all differ, more or less, from the actually observed practical results, as well as from each other. With a view to reconciling the theoretical and the practical aspects of the matter, Mr. Maskelyne suggested that a thorough and systematic investigation into the whole question of miniature locomotive performance should be made. The actual recorded achievement of Mr. Clogg's *Cock o' the East* was that the engine, hauling 550 lb., covered 19,350 ft. in 31 minutes. The distance, reduced to scale units, represents 87.84 scale miles; and, if the time required to cover this distance is 31 minutes, the speed is 170 scale m.p.h. as near as no matter, and no amount of theoretical calculation will alter

the fact. We would recommend "Jos." to study a carefully prepared paper by Mr. Johansen, of the L.M.S.R., Derby, dealing with experiments on model locomotives and trains, in connection with researches into the question of streamlining and its effect. One of the most important points revealed in that paper is that an estimation of the *performance* of the model, as distinct from mere speed, is essential to any conclusive results. But we are quite sure that Mr. Johansen and his colleagues would agree absolutely with our Editorial comments which "Jos." so lightheartedly asserts are "mistaken and incorrect."—Editor, "M.E."]

Improvising a Blower

DEAR SIR,—With reference to your correspondent's hint in the "M.E." of December 7th, on the improvising of a vacuum cleaner for a blower, may I state that the blowing back he experiences can be overcome very effectively by fitting the non-return valve, described by "L.B.S.C." in the "Live Steam" notes of July 18th, 1935. This fitting, made with a coffee tin and a cork flap, involves no alterations to the vacuum cleaner, and is very effective.

Yours sincerely,

Worcester Park. W. G. WEBB.

Reports of Meetings

The Society of Model and Experimental Engineers

The Annual Report and Accounts issued to all members shows that the Society has a total membership of 369, and that the financial position is very sound. The Rt. Hon. The Earl of Northesk has been re-appointed President, and Mr. Henry Greenly has been created a Vice-President in recognition of the many services rendered by him to the Society since its earliest days.

The Annual General Meeting was held at The Caxton Hall, Westminster, on Saturday, December 16th, 1939. The President was in the chair, and presented the silver medals and the "Allman" trophy to the competition winners.

The next Meeting will be held at The Caxton Hall, Westminster, on Saturday, January 13th, 1940, at 2.30 p.m., when a cinema programme of engineering films will be given.

Visitors' Tickets and full particulars of the Society may be obtained on application to the Secretary, H. V. STEELE, 14, Ross Road, London, S.E.25.

The Kent Model Engineering Society

On Friday, January 5th, the Annual General Meeting will be held at Society Headquarters, Sportsbank Hall, Catford, S.E.6, at 8 p.m.; each member should make a special effort to attend.

At the following meeting, on January 12th, Mr. T. Rowland will describe the building of his new locomotive.

Particulars of membership can be obtained on application to the Hon. Secretary, W. R. COOK, 103, Engleheart Road, S.E.6.

Stephenson Locomotive Society

The annual general meeting was held at the George Assembly Rooms, London, E.C.3, on December 9th, the President, Mr. J. N. Maskelyne, A.I.Loco.E., taking the chair and welcoming a large attendance. Notwithstanding the international situation, London Headquarters as well as provincial branches reported considerable increases in membership and sound financial position. Meetings for lectures and discussion are being resumed; the Society's monthly illustrated journal continues normally; but visits to locomotive works and sheds are perforce suspended; whilst owing to the evacuation of the L.N.E.R. dining club, in which it is mainly housed on tenancy terms, the activities of the library have been temporarily curtailed. The Newcastle centre is to be promoted from a sub- to full-branch status.

The newly-elected Hon. General Secretary, as from January 1st, 1940, MR. D. W. ALLEN, 44, Belsize Road, London, N.W.6, will be pleased to afford information as to membership and activities.

Mancunian Model Engineering Society

At our meeting on December 15th, Mr. Wilber gave us his talk on "Tool-Making." Mr. Wilber, who is a master of his craft, showed the members how to set out and make numerous time-saving gadgets which will prove very useful in the model maker's workshop. The lecture was enjoyed by an attentive audience, and brought forward a very hearty vote of thanks.

Meetings held each Friday at 8 p.m., at "Old Garrett Hotel," Princess Street, Manchester.

Hon. Secretary and Treasurer, H. STUBBS, 23, Ashdene Road, Heaton Mersey, Manchester.

NOTICES

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. Unless remuneration is specially asked for, it will be assumed that the contribution is offered in the general interest. All MSS. should be accompanied by a stamped envelope addressed for return in the event of rejection.

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall and Co. Ltd. 60, Kingsway, London, W.C.2. Annual Subscription, £1 10s. post free, to all parts of the world. Half-yearly bound volumes 17s. 6d., post free.

All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer." 60, Kingsway, W.C.2